APPENDIX

EXTANT BIODIVERSITY IN WRPA AND FAYOUM

1 Flora

1.1 Mosses

Mosses of Fayoum and Adjacent Areas

Taxa recorded	Oasis	Site of collection	Notes
CLASS: Bryopsida **Order: Fissidentales** **Family: Fissidentaceae Schimp** 1. ***Fissidens bryoides*** Hedw. var. ***gymnandrus*** (Büse) R. Ruthe.	Nile Fayoum	Zaw'yet El-Karadsa Bani Salem Ezbet Abou Shanab Ezbet El-Sheemi	Only sites in Egypt
F. viridulus (Sw.) Wahlenb.	Nile Fayoum	Ezbet Abou Shanab	
Order: Dicranales **Family: Ditrichaceae Limpr**. ***Ceratodon purpureus*** (Hedw.) Brid. var. ***rotundifolius*** Berggr.	Nile Fayoum	El-Zawia El-Khadhra Manshiy'yet Halpha Tobhar	Only sites in Egypt
Family: Dicranaceae Schimp. Subfamily: Anisothecioidea ***Dicranella rufescens*** (With.) Schimp.	Nile Fayoum	El-Qah'hafa	Only site in Egypt
ORDER: POTTIALES **Family: Pottiiaceae Schimp**. Subfamily: Trichostomoideae Subfamily: Merceyoideae ***Barbula bolleana*** (Mull.Hal.) Broth	Nile Fayoum	Sersena Zaw'yet El-Karadsa Ezbet El-Sheemi El-Zawia El-Khadhra And others	
B. unguiculata Hedw.	Nile Fayum	Sinnuris Tersa Abou Gensho El-Ghareeb near El-Ka'abi Fedimeen	
B. unguiculata Hedw. fo. ***robusta*** (Lindb.) Podp.	Nile Fayoum	Sersena Gabala	Only sites in Egypt
Didymodon fallax (Hedw.) R.H. Zander	Nile Fayoum	Sinnuris Ezbet El-shaikh Salem Tersa Manshiy'yet Halpha Kafr Mahfooze Ain Horrah	

	Farafra		
D. tophaceus (Brid.) Lisa	Nile Fayoum Farafra	Sinnuris Ezbet El-Shaikh Salem Sersena Zaw'yet El-Karadsa Between Ezbet El- Hadeer and El-Fayoum city Kafr Mahfooze Ain Beshowy	
D. vinealis (Brid.) R.H. Zander .	Nile Fayoum Bahariya	Sinnuris Bani Salem El-Sele'yeen El-Agamain El-Ghareeb near El-Ka'abi	
Gymnostomum aeruginosum Sm.	Nile Fayoum	Between El-Gareeb and El-Fayoum city Between Ezbet El-Hadeer and El- Fayoum city	
ORDER: FUNARIALES **∂Suborder: Funariineae** **Family: Funariaceae Schwägr**. ***Funaria hygrometrica*** Hedw.	 Nile Fayoum	El-Zawia El-Khadhra Manshiy'yet Halpha Tobhar Meniet El- Ga'afra Between El-Gareeb and El-Fayoum city and others	
•Suborder : Splachineae **Family: Splachnobryaceae A. Kop.** ***Splachnobryum obtusum*** (Brid.) Müll. Hal.	Nile Fayoum	El-Qah'hafa Fedimeen	Only sites in Egypt
Bryum alpinum Huds. ex With.	Nile Fayoum	Between Ezbet El- Hadeer and El-Fayoume El-Mokhtalata	
B. bicolor Dicks.	Nile Fayoum	Manshiy'yet Halpha Siy'ala (on the way to Demmo)	
B. caespiticium Hedw.	Siwa	Qareat Zammour, 29° 11´ N and 25° 32´ E	
B. elegans Nees	Nile Fayoum	El-Qah'hafa Siy'ala (on the way to Demmo) +	
B. gemmiparum De Not.	Nile Fayoum	Zaw'yet El-Karadsa Ezbet El-Sheemi Between Ezbet El- Hadeer and El-Fayoum city	

		+	
Family: Bartramiaceae Schwägr. ***Philonotis evanidinervis*** M. Fleisch.	Nile Fayoum	Sinnuris Ezbet El-shaikh Salem Sersena Gabala Zaw'yet El-Karadsa Ezbet Mekhaimer Yousef El-Sa-I-di-ya And others	
P. hastata (Duby) Wijk and Margad.	Nile Fayoum	Sinnuris Ezbet El-Shaikh Salem Sersena Gabala Kafr Mahfooze Ezbet Mekhaimer Yousef El-Sa-I-di-ya And others	
P. marchica (Hedw.) Brid.	Nile Fayoum	Gabala Teriet el-Gomhoriay Ezbet Bisheer Siy'ala Ezbet Et-Mahdi (Ebshowai) And others	
ORDER: ORTHOTRICHALES **Family: Orthotrichaceae Arnold** ***Zygodon obtusifolius*** Hook.	Nile Fayoum	Sinnuris Between Sersena and Gabala Manshiy'yet Halpha Etsa Qasr Kamel	Only sites in Egypt

1.2 Higher Plants

Psammophytic vegetation

The psmmophytic vegetation occupies flat expanses of wind-drifted sand 'the sand plains' and 'sand dunes' at different stages of development. The vegetation on the plains is usually richer in plant cover. The dominant species is *Alhagi graecorun*, associated with *Stipagrostis scoparia, Calotropis procera, Aerva javanica, Tamarix nilotica, Hyoscyamus muticus, Suaeda vermiculata, Cressa cretica. Reaumuria hirtella* and *Zygophyllum album.* On the older stabilized sand dunes *Tamarix nilotica* and *Alhagi graecorum* grow in abundance and may cover the summits and slopes of the dunes. In Baris, a southern village of Kharga, *Balanites aegyptiaca* (heglig or desert dates) and *Hyphaene thebaica* (doum palm) trees are seen among the dunes.

Xerophytic vegetation

The xerophytic vegetation occupies the desert ecosystem mainly around the oases and is practically a part of the Western Desert Flora, with an extensive list of vascular desert plants which is outside the scope of this study.

2. Fauna

Note: Aquatic animals, especially fish, exist in the Rayan nearby lakesbut only terrestrial animals are considered here.

2.1 Invertebrates

2.1.1 Soil Animals

Species listed here are those found in Fayoum.

Taxa	Fayoum
Carabidae	
Siagona europaea	+
sesostris	+
eurytus	+
clypeatus	+
minutus	+
tensicollis	+
Apotomus velox	+
varium	+
mixtum	+

Taxa	Fayoum
Tachys fumigatus geminatus	+
scutellaris aegyptiacus	+
lucasi	+
metallicus	+
ornatus	+
Pogonus gilvipes	+
Grayi	+
Melaenus elegans	+
Graniger semelederi	+
Abacetus stenoderus	+
Pterosticus barbarus	+
pharaoh	+

Orthotricus cymindioides	+

Taxa	Fayoum
Agonum nigrum	+
Daptus vittatus	+
Anisodactylus virens winthemi	+
Amblystomus levantinus laevistriatus	+
Acupalpus elegans	+
Tetragonoderus arcuatus	+
Microlestes corticalis	+
Glycia ornate	+
rufolimbata	+
unicolor	+
suturalis	+

Taxa	Fayoum
Cymindoidea tessellata	+
Zuphium olens kochi	+
Varum sp.	+
Parallelus riffaudi	+
Brachynus latipennis	+
Dytiscidae	
Hydrovatus clypealis	+

Taxa	Fayoum
Staphylinidae	
galeatus	+
Vitulus	+

Taxa	Fayoum
spectabilis	+
aegyptius	+
wittmeri	+
Medon debilicornis	+
ochraceus	
Lathrobium torretassoi	+
Achenium cribriceps	+

Taxa	Fayoum
Tachyparus nitidulus	+
Aleochara bipustulata	+
Malachiidae	
Cephaloncus aegyptiacus	+
Dasytidae	
Microjulistus wegeneri	+

Taxa	Fayoum
Anobiidae	
Xyletinus bucephalus	+
Lasioderma serricorne	+
Elateridae	
Cardiophorus humilis	+
Buprestidae	
Acmaeodera udspersula	+
kindermanni	+
viridis	+
Mimosa cyanea	+

Taxa	Fayoum
Sphenoptera dongolensis	+
trispinosa	+
Agrilus derasofasciatus	+
Aphanisticus aegyptiacus	+
Hydrophilidae	
Helochares melanophthalmus	+
maculiaper	+

Taxa	Fayoum
Dermestidae	
Phradonoma cercyonoides demaisoni	+
Anthrenus crustaceus	+
rotundatus	+
Lathridiidae	
Hyperaspis marmottani	+
Anthicidae	
Leptaleus unifasciatus	+

Taxa	Fayoum
Anthicus armatus	
bremei	+
phoxus	+
wegeneri	+
testaceipes	+
floralis	+
Meloidae	
Mylabris menthae	+
Meloe proscarabaeus	+

Taxa	Fayoum
Mordellidae	
Anaspis lutea	+
Tenebrionidae	

Oxycara pygmaeum	+
Pogonobasis ornate	+
Scaurus puncticollis puncticollis	+
Hispida	
major	+
latreillei	+
canescens canescens	+
angulata angulata	+
Blaps polychresta	+

Taxa	Fayoum
Opatrinus corvinus	+
Scleron orientale	+
Opatroides punctulatus	+
Cechenosternum rufulum nigrosuturale	+
Cossyphus moniliatus	+

Taxa	Fayoum
Scarabaeidae	
Oniticellus pallens	+
Onthophagus melanocephalus	+
lividus	+

Rhyssemus goudoti	+
Physsemodes orientalis	+
Pleurophorus caesus	+
Hybosorus illigeri	+
Heteronychus licas	+
Tropinota squalida	+

Taxa	Fayoum
Chrysomelidae	
Cyaniris unipunctata	+
venusta	+
Stylosomus niloticus multinotatus	+
Cryptocephalus brunicollis innesi	+
maculicollis	+
*punctatissimus**	+
Chloropterus pallidus	+
Diorhabda elongata sublineata	+
Chaetocnema tibialis	+
Bruchidae	
Bruchus angustifrons	+
baudoni	+
fulvus	+
incarnatus	+
poupillieri	+
sahlbergi	+

* *signatithorax*

Taxa	Fayoum
B. trifolii	+
quadrimaculatus	+
Pseudopachymerus lallemanti	+
Spermophagus sericeus	+
Scolytidae	
Phloeotribus scarabaeoides	+
Curculionidae	
Phacephorus nubeculosus	+
Tanymecus musculus	+
Ocellatus	+
Coniatus laetus	+
aegyptiacus aegyptiacus	+
Cleonus kahirinus	+
clathratus	
Vittiger	+
brevirostris	+
Lixus nubianus	
astrachanicus	+

Taxa	Fayoum
L. soricinus	+
Geranorrhinus suturalis	+
Smicornyx rufipennis	+
Arthrostenus alternans	+
Apion tamaricis	+
Corimalia latifrons	+
Letourneuxi	+
martini	+
Mutica	+
Setulosa	+
Lepidotychius morawitzi	+
Gymnetron melinum molle	+

spitzyi nesapia	+

2.1.2 Arachnida

Arachnida in Wadi El-Rayyan
Arranged by Families

Spiders [11 families, 15 genera, 16 species]

Family	Genera	Species	Family	Genera	Species
Agelenidae	1	1	Oxyopidae	2	2
Araneidae	2	3	Philodromidae	2	2
Eresidae	1	1	Salticidae	1	1
Gnaphosidae	2	2	Tetragnathidae	1	1
Lycosidae	1	1	Thomisidae	1	1
Miturgidae	1	1			

Scorpions [1 family, 2 genera, 2 species] Buthidae
Sunspiders [1 family, 1 genus, 1 species] Galeodidae
Pseudoscorpions [1 family, 1 genus, 1 species] Olpiidae

2.2 Vertebrates

2.2.1 Amphibia and Reptiles

Taxa	Fayoum
Agamidae	
Laudakia stellio stellio	+
Trapelus mutabilis	+
Gekkonidae	
Hemidactylus turcicus	+
Ptyodatcylus guttatus	+
Stenodactylus sthenodactylus	+
Lacertidae	
longipes	+
Scincidae	
Chalcides ocellatus ocellatus	+
Sphenops sepsoides	+

* *stenodactylus*

Taxa	Fayoum
Leptotyphlopidae	
Leptotyphlops macrorhynchus	+
Boidae	
Eryx colubrinus colubrinus	+
Colubridae	
Coluber florulentus	+
nummifer	+
Dasypeltis scabra	+
Lycophidion capense capense	+

Malpolon moilensis	+
monspessulana insignita	
Psammophis schokari aegyptius	
sibilans sibilans	+

Taxa	Fayoum
Elapidae	
Naja haje haje	+
Viperidae	
Cerastes vipera	+
Cerastes cerastes	+

2.2.2 Birds

The Western Desert of Egypt covers one of the most arid parts of the world supporting a relatively low biodiversity that is, nevertheless, of considerable biological interest. As regards the bird species, few breed, and these are catalogued in the attached lists. Only one of the areas covered in this summary, Farafra (White Desert), Siwa, Bahariya and the desert areas of Wadi Rayyan, is scheduled in Baha El Din (1999), as an "Important Bird Area", according to the criteria of "Birdlife International" and that is Wadi Rayyan, but based largely on the avifauna of the two lakes there. The breeding birds of these sites are summarized below.

The Breeding Birds of Wadi Rayyan*
(after Goodman and Meininger 1989)

Little Bittern *Ixobrychus minutus*
Cattle Egret *Egretta ibis*
Little Egret *Egretta garzetta*
Black-shouldered Kite *Elanus caeruleus*
Kestrel *Falco tinnunculus*
Moorhen *Gallinula chloropus*
Purple Gallinule *Porphyrio porphyrio*
Senegal Thick-knee *Burhinus senegalensis*
Cream-coloured Courser *Cursorius cursor*
Kittlitz's Sandplover *Charadrius pecuarius*
Kentish Plover *Charadrius alexandrinus*
Spur-winged Plover *Hoplopterus spinosus*
Rock Dove *Columba livia*
Palm Dove *Strptopelia senegalensis*
Senegal Coucal *Centropus senegalensis*
Eagle Owl *Bubo bubo*
Egyptian Nightjar *Caprimulgus aegyptius* **
Little Green Bee-eater *Merops orientalis*
Blue-cheeked Bee-eater *Merops superciliosus*
Hoopoe *Upupa epops*
Hoopoe Lark *Alaemon alaudipes* **
Crested Lark *Galerida cristata*
Sand Martin *Riparia riparia*
Swallow *Hirundo rustica*
Common Bulbul *Pycnonotus barbatus*
Rufous Bush-chat *Cercotrichas galactotes*

Mourning Wheatear *Oenanthe lugens* **
Fan-tailed Warbler *Cisticola juncidis*
Graceful Warbler *Prinia gracilis*
Clamorous Reed Warbler *Acrocephalus stentoreus*
Olivaceous Warbler *Hippolais pallida*
Great Grey Shrike *Lanius excubitor*
Hooded Crow *Corvus corone*
Brown-necked Raven *Corvus ruficollis*
House Sparrow *Passer domesticus*
Goldfinch *Carduelis carduelis*
*Includes lake areas of Wadi Rayan
** Characteristic of the Saharo-Sindian biome

Significant Bird Species.
Wadi El-Rayan is included in Birdlife International's inventory of IBAs in Egypt, and that largely due to the two large lakes, wetland areas.

2.2.3 Mammals

Taxa	Fayoum
Insectivore	
Erinaceidae	
Hemiechinus auritus aegyptius	+
Soricidae	
Crocidura flavescens	+
Chiroptera	
Rhinopomotitdae	
Rhinopoma hardwickei arabium	+
Emballonuridae	
Taphozous perforatus	+
Hipposideridae	
Asellia tridens	+
Rhinolophidae	
Rhinolophus clivosus brachygnathus	+
Vespertilionidae	
Pipistrellus kuhli	+
Otonycteris hemprichi	+
Lagomorpha	
Leporidae	
Lepus capensis rothshildi	+
Rodentia	
Muridae	
Rattus rattus	+
Mus musculus	+
Nesokia indica	+
Arvicanthis niloticus	+
Cricetidae	
Gerbillus gerbillus	+

gerbillus	
andersoni andersoni	+
Dipodillus campestris wassifi	+
amoenus	+
Meriones shawi	+
Pachyuromys duprasi	+
Psammomys obesus obesus	+
Spalacidae	
Spalax ehrenbergi	+
Muscardinidae	
Eliomys quercinus cyrenaicus	+
Dipodidae	
Jaculus jaculus jaculus	+
Hystricidae	
Hystrix cristata	+
Carnivore	
Canidae	
Canis aureus	+
Vulpes rueppelli rueppelli	+
zerda	+
Mustelidae	
Poecilictis libyca	+
Viverridae	
Herpestes ichneumon	+
Hyaenidae	
Hyaena hyaena	+
Felidae	
Felis chaus	+
F. sylvestris tristrami	+
Artiodactyla	
Bovidae	
Gazella leptoceros	+
G. dorcas dorcas	+
Ammotragus lervia	+

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Research on the Origin and Early Evolution of Whales (Cetacea)

Introduction

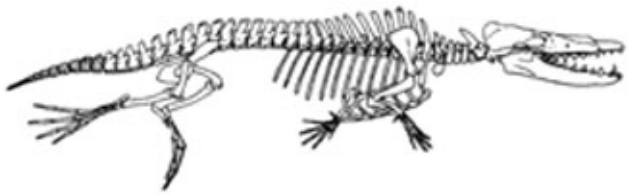
The mammalian order Cetacea is divided into three suborders: (1) Oligocene to Recent **Odontoceti** or 'toothed whales'— living today; (2) Oligocene to Recent **Mysticeti** or 'baleen whales'— living today; and (3) older and more primitive Eocene **Archaeoceti** or 'archaic whales'— which evolved to give rise to odontocetes and mysticetes. My research on the origin and early evolution of whales is focused on archaeocetes. I have been fortunate to work with many colleagues on this in Pakistan, Egypt, and India (see co-authors in the publication list below). The stages of early whale evolution that we have documented are shown here in Figure 1. We have been fortunate to find virtually complete skeletons of middle-to-late Eocene Basilosauridae, exceptionally complete skeletons of middle Eocene Protocetidae, and a partial skull of earliest middle Eocene Pakicetidae. Recovery of diagnostic ankle bones in the skeletons of primitive protocetids during our field work in Pakistan in 2000 confirmed their derivation from Artiodactyla (the mammalian order including cows, deer, hippos, etc.), and showed convincingly that whales did not originate from mesonychid condylarths as Van Valen hypothesized (and we expected).

Field Work in Egypt (1983-1993)

In the 1980s field work on archaeocetes shifted to Egypt, to the classic but long-neglected site of Zeuglodon Valley or, today, Wadi Hitan. Our camp in the desert in Wadi Hitan is shown in Figure 2, and a *Basilosaurus* excavation in progress is shown in Figure 3. Our most interesting discovery came in 1989, when we found that both *Basilosaurus isis* and *Dorudon atrox* retained feet and toes (see Figures 4 and 5). This discovery then led to renewed investigation of middle Eocene whale strata in Pakistan, especially in the area where we earlier joked about 'walking whales'.

Additional whales described from Wadi Hitan and Fayum Province in Egypt include *Ancalecetus simonsi* (Gingerich and Uhen, 1996) and *Saghacetus osiris* (see Gingerich, 1992).

D. *Dorudon* (Basilosauridae) from the middle to late Eocene of Egypt



C. *Rodhocetus* (Protocetidae) from the early middle Eocene of Pakistan

B. *Pakicetus* (Pakicetidae) from the earliest middle Eocene of Pakistan

A. *Elomeryx* (Anthracotheriidae) from the Oligocene of Europe, North America, Asia

Figure 1. Skeletons of the archaeocetes *Dorudon atrox* and *Rodhocetus balochistanensis* compared to that of *Elomeryx armatus*, which is here taken as a model for the extinct group of artiodactyls (Anthracotheriidae, *s.l.*) that we now think may have given rise to archaic whales. *Pakicetus* has a distinctive skull and lower jaw, but is not demonstrably different from early protocetids postcranially. **Note changes in body proportions and initial elongation of feet for foot-powered swimming in *Rodhocetus*, then later reduction of the hind limbs and feet as the tail-powered swimming of modern cetaceans evolved in *Dorudon*.**

A. *Elomeryx* drawing from W. B. Scott, first published in 1894. **B**. *Pakicetus* skull from Gingerich et al. (1983). **C**. *Rodhocetus* skeletal reconstruction from Gingerich et al. (2001). **D**. *Dorudon* skeletal reconstruction from Gingerich and Uhen (1996).

Figure 2. University of Michigan camp in Wadi Hitan, Egypt. This area, approximately 10 x 10 km, was studied in 1983, 1985, 1987, 1989, 1991, and 1993, during which time some 400 archaeocete and sirenian skeletons were found and mapped. These range in preservation from virtually complete specimens just being exposed by erosion to the last remnants of specimens destroyed by the wind. Photograph ©1991 Philip Gingerich.

Figure 3. Dr. B. Holly Smith working at the base of the tail at a *Basilosaurus isis* excavation in Wadi Hitan, Egypt. We are particularly interested in this part of the skeleton because this is where the reduced hind limbs, feet, and toes are found (see Fig. 4). Photograph ©1991 Philip Gingerich.

Figure 4. Ankle, foot, and toes of *Basilosaurus isis* excavated in Wadi Hitan, Egypt. This find was described in Gingerich et al. (1990). The foot as shown is approximately 12 cm long. Photograph ©1991 Philip Gingerich.

Figure 5. Hind limbs, feet, and toes of a virtually complete skeleton of *Dorudon atrox* excavated in Wadi Hitan, Egypt. Note the retention of hind limbs, feet, and toes like those found in *Basilosaurus*. This find is described in Uhen (1996, 2003). The skeleton is approximately 5 m long. Photograph ©1998 Philip Gingerich.

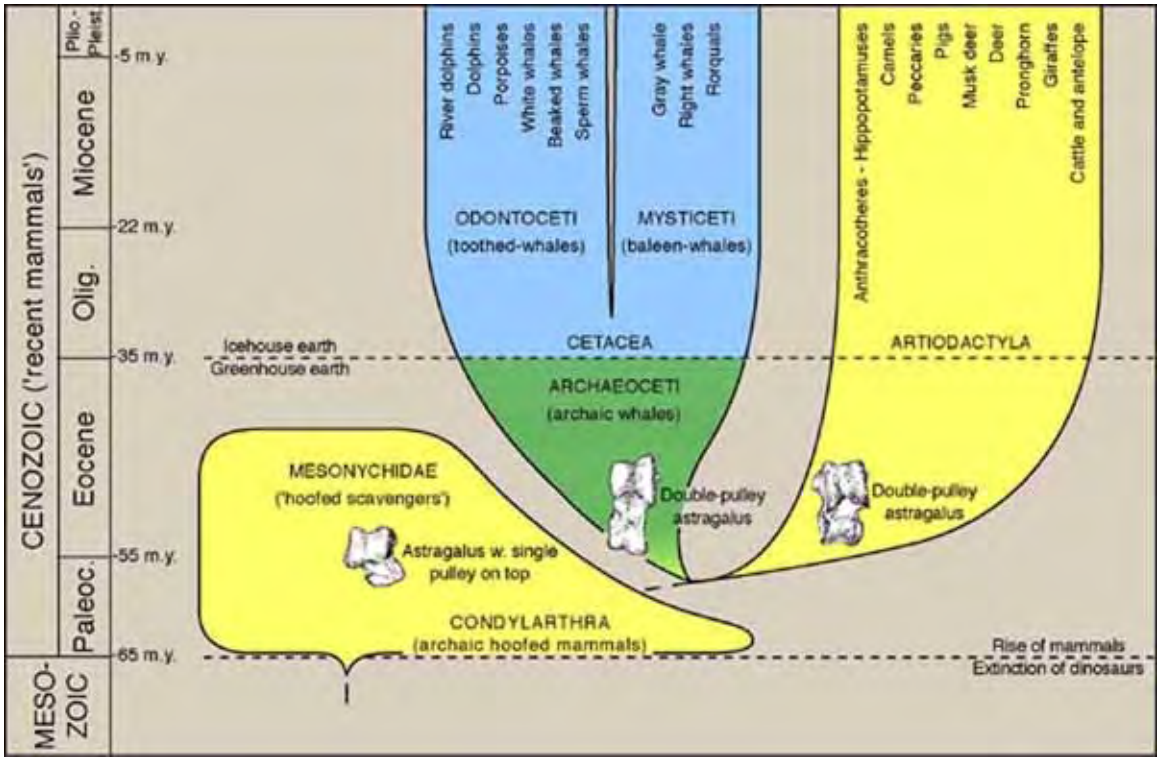


Figure 6. Phylogeny of Cetacea showing a common ancestry shared with Artiodactyla, and the hypothesized evolutionary origin of both from older Paleocene age Condylarthra. Horizontal axis is arbitrary, while the vertical axis is geological time. Our 2000 discovery of distinctively artiodactyl-like double-pulley astragalus bones in articulated skeletons of early archaeocetes is the principal evidence linking whales and artiodactyls as shown here (see Gingerich et al., 2001). The evolutionary origin of both whales and artiodactyls is closely tied to the Paleocene-Eocene boundary, and the transition from archaeocetes to modern whales is related to climatic and ocean circulation changes at the Eocene-Oligocene boundary. Source: University of Michigan Museum of Paleontology.

History of search for early whale fossils

A decade or so passed before paleontologists finally began unearthing fossils close enough to the evolutionary branching point of whales to address Van Valen's mesonychid hypothesis. Even then, the significance of these finds took a while to sink in. It started when University of Michigan paleontologist Philip Gingerich went to Pakistan in 1977 in search of Eocene land mammals, visiting an area previously reported to shelter such remains. The expedition proved disappointing because the spot turned out to contain only marine fossils. Finding traces of ancient ocean life in Pakistan, far from the country's modern coast, is not surprising: during the Eocene, the vast Tethys Sea periodically covered great swaths of what is now the Indian subcontinent. Intriguingly, though, the team discovered among those ancient fish and snail remnants two pelvis fragments that appeared to have come from relatively large, walking beasts. "We joked about walking whales," Gingerich recalls with a chuckle. "It was unthinkable." Curious as the pelvis pieces were, the only fossil collected during that field season that seemed important at the time was a primitive artiodactyl jaw that had turned up in another part of the country.

By 1983 Gingerich decided to cast his net in Egypt instead, journeying some 95 miles southwest of Cairo to the Western Desert's Zeuglodon Valley, so named for early 20th-century reports of fossils of archaic whales—or zeuglodons, as they were then known—in the area. Like Pakistan, much of Egypt once lay submerged under Tethys. Today the skeletons of creatures that swam in that ancient sea lie entombed in sandstone. After several field seasons, Gingerich and his crew hit pay dirt: tiny hind limbs belonging to a 60-foot-long sea snake of a whale known as *Basilosaurus* and the first evidence of cetacean feet. Here in the middle of the Sahara Desert hundreds of whale skeletons lie buried in sandstone. Gingerich's excitement turned to disappointment when he found that most of the skeletons were *Basilosaurus,* an already known aquatic whale ancestor. But Gingerich kept on digging. A few days later he made a new discovery—*Basilosaurus* had legs. Even though *Basilosaurus* was fully aquatic, it still had vestiges of its terrestrial past. Ten million years of whale evolution had passed between *Pakicetus* and *Basilosaurus,* and yet whales still had hind legs and feet. Now the challenge for Gingerich and his colleagues was to .ll in the fossil gaps of whale history.

Earlier finds of *Basilosaurus,* a fully aquatic monster that slithered through the seas between some 40 million and 37 million years ago, preserved only a partial femur, which its discoverers interpreted as vestigial. But the well-formed legs and feet revealed by this discovery hinted at functionality. Although at less than half a meter in length the diminutive limbs probably would not have assisted *Basilosaurus* in swimming and certainly would not have enabled it to walk on land, they may well have helped guide the beast's serpentine body during the difficult activity of aquatic mating. Whatever their purpose, if any, the little legs had big implications. "I immediately thought, we're 10 million years after *Pakicetus*," Gingerich recounts excitedly. "If these things still have feet and toes, we've got 10 million years of history to look at." Suddenly, the walking whales they had scoffed at in Pakistan seemed entirely plausible.

Gingerich Publications on Egyptian fossil whales (chronological order)

Gingerich, P. D., B. H. Smith, and E. L. Simons. 1990. Hind limbs of Eocene *Basilosaurus isis*: evidence of feet in whales. *Science*, 249: 154-157.

Gingerich, P. D. 1992 . Marine mammals (Cetacea and Sirenia) from the Eocene of Gebel Mokattam and Fayum, Egypt: stratigraphy, age, and paleoenvironments. *University of Michigan Papers on Paleontology*, 30: 1-84.

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Uhen, M. D. Uhen. 1996. *Dorudon atrox* (Mammalia, Cetacea): form, function, and phylogenetic relationships of an archaeocete from the late middle Eocene of Egypt. *Ph.D. dissertation, University of Michigan*, Ann Arbor, 608 pp.

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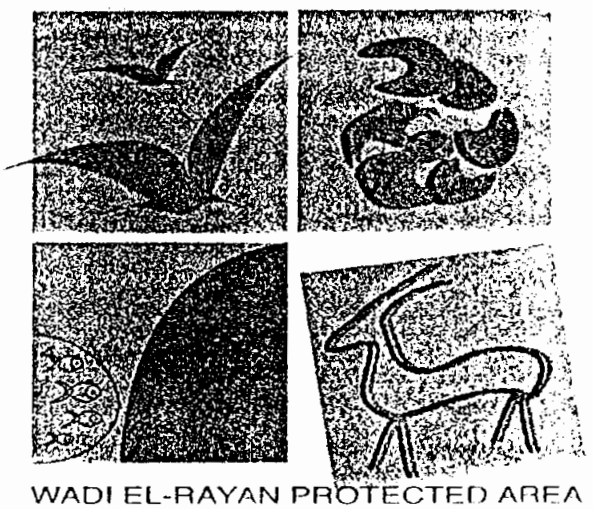
OPERATING PLAN

WADI EL-RAYAN PROTECTED AREA

محمية وادى الريان



Prepared by

Wadi El-Rayan Protected Area staff
EEAA

COOPERAZIONE ITALIANA
التعاون الايطالي

IUCN
The World Conservation Union

المحميات الطبيعية بمصر
NATIONAL PARKS OF EGYPT

July 2003 – June 2004

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CONTENTS PAGE

List of abbreviations

DGCD	Directorate General Co-operation Development (Italian Foreign Ministry)
EEAA	Egyptian Environmental Affairs Agency
EIA	Environmental Impact Assessment
EIEP	Egyptian Italian Environmental Program
GOE	Government Of Egypt
IUCN	World Conservation Union
NCS	Nature Conservation Sector
PA	Protected Area
PAMU	Protected Area Management Unit
PCU	Program Coordination Unit
TA	Technical Assistance
TOR	Terms of References
UTC	Unita Tecnica Centrale (DGCD)
UTL	Unita Tecnica Locale (DGCD)
WRPA	Wadi El-Rayan Protected Area
WRPAMU	Wadi El-Rayan Protected Area Management Unit

List of tables

PART 1
1. Introduction

1.1. THE OPERATING PLAN

This plan has been drawn up in accordance with the management planning system for the protected areas of Egypt. This operating plan is a one-year work program whose objective is the implementation the Wadi El-Rayan Protected Area Management Plan (2002 – 2006). The operating plan is fully aligned with the management plan and the format of the operating plan follows the format of the management plan.

1.2. PREPARATION OF THE OPERATING PLAN

It is the responsibility of Protected Area Manager to prepare the annual operating plan.

The background, site description and evaluation, management issues and constraints of Wadi El-Rayan Protected Area (WRPA) are described in the Management Plan document and are not repeated here in order to keep the operating plan document brief.

1.3. APPROVAL OF THE OPERATING PLAN

After preparing the plan the Protected Area Manager submits it to the NCS/EEAA for approval. After the approval of the operating plan and its budget by NCS, the approved operating plan is used by the Protected Area Manager as his work plan for the year.

1.4. REPORTING

Reports on the protected area prepared by the Protected Area Manager will follow the format of the operating plan and will report on progress in achieving the objectives set out in the management plan.

1.5. PROJECT SECOND PHASE

The WRPA project was funded by the Italian-Egyptian Environmental Program in the first phase (March 1998 - February 2001) and implemented by EEAA with international technical assistance from the World Conservation Union (IUCN). The transition phase of the WRPA project started in June 2001 and ceased in December 2002. As one of the components of a broader support programme to the Egyptian Environmental Affairs Agency (EEAA), Nature Conservation Sector (NCS), funded by the Development Co-operation General Directorate (DGCS) of the Italian Foreign Ministry, the second phase of WRPA project is due to commence in 2003.

PART 2
2. Management Goals and Objectives

OVERALL GOAL AND OBJECTIVES

The overall management goal of the protected area is the protection of the natural resources in accordance with the declaration decree of the protected area (943/1989) and follows the general protection rules of the law 102/1893.

The protected area as a whole has been identified to follow two broad conservation management objectives using the category classification system of IUCN and these are category II and VI (see management plan). Each category has its own management objectives. Details are given in the management plan.

The operating plan is the main annual tool to implement and achieve the management objectives of the management plan for each category.

PART 3
3. Zone Plan

Table (1) Zoning system of WRPA

Protection Level	Name of Zone	Activities permitted
Zero impact A	☐ Special Protection Zone ☐ Strict Natural Zone	☐ Under investigation. ☐ Visitor use and educational plan is urgently needed ☐ Studies and research under specific authorization and control. ☐ Habitat exploitation is prohibited. ☐ Tourism and Economic activities are not allowed.
Low impact B	Reserve Protection Zone	☐ Studies and research under specific authorization and control ☐ Eco-tourism only after authorization of WRPA.
Moderate impact C	Recreational Zone	☐ Tourism and tourism facilities and recreation ☐ Bird watching ☐ Camping ☐ Pathway for the traditional fishing activities
High impact D	Development Zone	☐ Controlled habitat exploitation ☐ Long-term high impact projects of the black and grey lists (according to the Egyptian settings) ☐ High-density tourism is allowed.

Details of the zone plan are given of the management plan (Figure 1)

PART 4
4. Management Strategies and Actions

Development of clear strategies for the management of WRPA is one of the desired outputs of the management plan covering the period 2002-2006. The strategies as well as the future well-studied actions will contribute to the process of effective environmental management in the protected area.

4.1. SPECIFIC MANAGEMENT STRATEGIES

4.1.1. Collaborative management will be given a high priority.

At a special meeting with the Governor of Fayoum, Professor Saad Nasaar, held on 14 October 2002, the Governor expressed his appreciation to the WRPA Manager for initiating the management planning process for WRPA. He described the Management Plan as an essential tool to achieve the required level of coordination between the various public agencies active in the Protected Area and undertook to advise all the relevant departments in the Governorate that they should give the Management Plan their full support.

The following departments have already given their formal support endorsement of the Management Plan.

- The Irrigation and Water Resources Department
- The Tourism Department
- The General Authority for Development of Fish Resources.
- The Water and Environmental Police
- Security Department

A first meeting was held with the Security Department on 15 October 2002 to discuss the Management Plan.

Meetings with other key stakeholders will follow a definite schedule (2002-2003)

Seasonal meetings with the key governmental and non-governmental stakeholders will be given a high priority. The meetings will have the purpose of 1) updating the stakeholder with the new management achievements and constraints and 2) giving awareness to WRPA towards the new plans or changes of the activities related to a definite stakeholder inside WRPA. Meetings are expected to be organized on January, April, July and October of 2003. The outputs of those meetings will support and feed the management of the protected area.

List of Stakeholders

Governmental

- Ministry of Irrigation and Water Resources (The Irrigation and Water Resources Department)
- Ministry of tourism (The Tourism Department)

- Ministry of Agriculture and Land Reclamation (The General Authority for Development of Fish Resources - Land Reclamation Sector for Northern Upper Egypt)
- Ministry of Interior (Security Department - The Water and Environmental Police)
- Ministry of Defence
- Ministry of Petroleum (Quarun Petroleum Company)
- Governorate of Fayoum

Private Sector

- Intensive Fish Farm
- Extensive Fish Farm
- Cafeterias
- Safari Camp

A copy of the management plan will be delivered to each of the stakeholders

4.1.2. Special attention will be given to improving control over water use in the lake system.

Inflow into the tunnel that feeds the upper lake is the surplus runoff water from the El-Fayoum irrigation system and the amount varies depending on the amount of water recycled for irrigation before it reaches the tunnel. According to the Water Resources Department the extraction and evaporation of water from the lake system is currently greater than the inflow, and the allocation to each user will have to be reduced.

It is also their recommendation that the Nature Conservation Sector should request a technical meeting on water supply to the Wadi El- Rayan lakes, held under the chairmanship of the Governor of Fayoum. The meeting will discuss the water allocations to the different water users in the system. WRPA staff supports the recommendation and will request NCS to arrange the meeting.

As the fact that the water resources of the protected area, which represented mainly in the water of the Rayan lakes, are now under severe danger of depletion due to their overuses, a great attention paid for the management of these resources.

Several meetings were held in that sense:

- Dutch project supporting the irrigation department in Fayoum

- Under secretary of irrigation department in Fayoum

The major outputs from these sides had been recommend to the higher ministerial level stopping of all the activities related to land reclamation or fish farming activities inside Wadi El-Rayan area. A stage of data importing from these sides has been established and realization of the current situation is going to be ready through the next couple of weeks.

Data on lake water levels from Fayoum Irrigation Department confirms that the lake levels are decreasing.

4.1.3. Adaptive management will be applied to ensure that the plan objectives are achieved.

Results obtained from the monitoring programs will be continuously evaluated and the management actions will be adapted where necessary to ensure that the management objectives set out in the management plan are being achieved. A system of annual reporting for the monitoring activities is acting and feeding the management unit with the new inputs insuring satisfactory management achievements.

4.1.4. Management actions will cover the three core protected area functions of natural resources protection, public use and public awareness and community outreach.

Each function is described in the management plan and the specific actions are described in section 4.3. of this plan.

4.1.5. Management will be focused at the management zone level

Each zone has its own unique management objective, and management actions will be focused mainly at the management zone level to ensure that the specific management objectives of each zone are achieved.

4.2. GENERAL ACTIONS

4.2.1. Law Enforcement & Patrolling

The regulations and rules are listed in the management plan

Law Enforcement

This item is divided into three stages as follows:
1. Enforcement of law 102/1983 and its executive decrees terms inside the protected area
2. Judicial procedures
3. Penalties implementation

1. Enforcement of law terms inside the protected area

The protected area manager will keep a copy of all licenses in the office.

Any violations occurred during the daily activity (patrolling) meet with police report submitted by WRPA to the water police station.

In case of major violation, violator and equipment or tools is being under arrest to be accompanied to the water police station. Coordination between WRPA and water police is taking place to arrest violators. Rangers will record each violation in the law enforcement form.

2. Judicial procedures

After submitting the police report to the water police, they transmit it to the main police station in Abshaway district then to the prosecutor and finally to the court.

3. Penalties implementation

According to the criminal procedures law the implementation of all crimes penalties decided by the court is entrusted to the investigation bureau (police detectives dept.), less considered given to environmental cases by that bureau in comparison with the big responsibilities given to that bureau.

Patrolling

Patrolling is the direct way to assess the general changes and violations towards the resources of the protected area. Patrolling is an essential tool to achieve the law enforcement procedure that ensures keeping respect for the natural & cultural resources and natural beauty of the area. The following patrolling system for patrolling will be followed for the different key areas of the protected area:

Area	No of Patrols/Week
Spring Area	2
Fossil Area	3
Second Lake	3
First Lake	3
Land Reclamation Drainage system	1
Oil Company	1
Water Falls Area	7
Fish Farms	2

Patrolling will be done by foot, by vehicle and by boat
The usual legal procedure must be taken against the different violations in different areas of the protected area by the lawyer of WRPA.

Patrolling will be done according to the procedure manual

4.2.2. Monitoring Programs

Scientific monitoring is the main way to assess the minute and major changes of the available natural resources of the protected area. As biotic and abiotic elements of resources have been existed in WRPA, the following management programs had been adopted:

I. Biodiversity Monitoring Program (Achieve through Biodiversity Unit of WRPA)

II. Resource Monitoring Program

III. Economic Activities Monitoring Program

I. Biodiversity Monitoring Program

I.1. Vegetation Monitoring

Sampling Program

Stratified Sampling methods were used that the vegetation is divided up before samples are chosen according to variations within it, on the basis of difference in vegetation structure and variation in dominant species.

Five main terrestrial habitats were selected as the study area for the monitoring program in which sampling sites were selected to cover five main natural habitats all over WRPA.

A total of 12 stands were selected to represent the variations in the vegetation communities inside the area. The stands were distributed among the main important sectors of the protected area as explained by the table:

Sector	No. of Stands
Fossil Area (FA)	2
Upper Rayan Lake (UL)	2
Lower Rayan Lake (LL)	2
Spring Area (SA)	5
Rowayan Area (R)	1
TOTAL	**12**

The abundance of each plant species in each stand (Line intercept method) was estimated during the period from 1st Nov. to 8th Nov. 2001

The area of each stand was determined as 100 m2.

Species identification and species names were according to Täckholm (1974) and Boulos (1995), and mainly identified through the herbarium of WRPA.

Methodology

The vegetation cover was estimated on the bases of mean absolute cover of certain sp. inside the 100 m2 area of each stand. The quadrate was divided into 10 tapes of 10 m long for each. The value of absolute cover of certain sp. was obtained by measuring the distance cut by the sp. for each of the 10 tapes. The mean of the sum of all the measured distances cut by a sp. for all the tapes of 100 m long was represented the mean absolute cover for the sp. The relative cover of each species was calculated through the equation: absolute cover of the sp. / total absolute cover of all the sp. multiplied by 100.

I.2. Mammal Monitoring

Time of Monitoring

Four time per year (Seasonal monitoring)
- Spring (from 21 April to 20 May).
- Summer (from 21 July to 20 August).
- Autumn (from 21 October to 20 November).
- Winter (from 21 January to 20 February).

Transects Locations

Five locations by ten transects to cover the whole protected area:

- Springs area (three transects)
- Rowayan area (one transect)
- Second lake (two transects)
- First Lake (two transect)
- Fossil area (two transect)

Mammals observation (survey)

Two times per each month, We need one car and one driver and we will start the work early from 6 A.M. until 3 P.M. or in the evening from 8 P.M. to 12 P.M.

Methodology

The methodology that the WRPA staff is using with wildlife count is the index count for presence signs along strip transects. These counts will allow to compare differences concerning wildlife abundance between different habitats and to monitor distribution changes seasonally and over long periods of time.

The main features of this method are the following:

Personnel: transects were surveyed using 2-persons team, an observation and a recorded

Equipment: compass, GPS, pencils, binocular and data sheets.

Frequency: Each transects is walked every 3 months (seasonal monitoring) within a defined two-week period.

Method: Transects have been located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the mammals in WRPA (stratified sampling). Each transect is 2 Km in length and 10 meters in wide and it is walked at constant speed of about 3 Km/hour. The observers record the species and the kind of sign (track or feces) that they found inside the transect strip.

I.3. Bird Monitoring

Counting

The WRPA staff used for counting of the most common species of water-bird is the line transect method from the motorboat along fixed transects in the Upper and Lower Lakes. Seasonal dynamics of birds in Wadi El Rayan will be studied by point count throughout fixed stands in protected area different habitats.

Personnel: team of two persons (trained in bird identification)

Equipment: compass, GPS, binoculars, telescope, pencils and data sheets.

Frequency: Each transect is walked twice at quarterly intervals within a defined two-week period, during the first half of the morning.

Method: The selected transects were located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the birds in WRPA (stratified sampling). Each transect is 1 Km in length and the motorboat is driven at constant speed

of about 3 Km/hour. The observers record the species, the direction and the distance of each bird resting on the lake or feeding in a place. For species that occur in flocks, they treat the flock as a single detection and record the flock size. The position recorded for a flock is the "center of gravity" of the flock, not the closest point of the flock to the observer. The flying birds are recorded and analyzed separately: whenever a flying bird (or flock) is detected, the observer wait until it comes abeam of the boat and only then he records its position. In point counts, we record all birds species observed in each point using telescope and this count will be every 15 days during winter and migration seasons.

Ringing

The method used for bird ringing was conducted following the standard of the SEEN program (SE European Migration Network, Bird Migration Research Station, Gdansk Univ. Poland) including measurements (wing length, tail length, wing formula, fat score, and bird weight).
Personnel: four persons are usually working in the ringing station, two from Poland and two Egyptians.

Equipment: Nets, Field guides, rulers, balance, experiments cages, compass, rings and one car.

Methods: The used for bird ringing depends on birds catching especially passerines using especial nets (mist net) with certain mesh size according to the encountered group of birds. All the birds caught were identified, sexed, and aged. And birds' measurements will be taken and migrants directional preference will be tested,

Frequencies: this work is carried out during the migration seasons (spring1st of Mar. - end of Apr. and autumn, 1st of Sep. - end of Oct.) the wok is starting (from 6:30 to 11: 00 o'clock) in the morning and (from 17.00 to 19: 30 o' clock) in the evening.

I.4. Fish Monitoring

Traditional Fishing

Three time per year (Seasonal monitoring)
- Autumn (the period from 13 to 17 October).
- Winter (the period from 13 to 17 January).
- Spring (the period from 13 to 17 April).

Methodology

Data about fish (breeding season, size and weight) and nets (mesh size, net length and net depth) will be collected by field survey to the fishermen and boats.

Another data collection method will done in an official way from the General Authority for Development of fish Resources to record the total harvest of fishes for the both of Rayan lakes at the opening season for fishing.

Location

Field survey

Upper Lake

1- The main fish collection unit.

2- Abo Rokba fish collection unit.
3- Bacarat fish collection unit.
Lower lake
1- Waterfall fish collection unit.
2- Horria fish collection unit.

II. Resource Monitoring Program

II.1. Water Quality Monitoring Program

Sampling Program & Methodology

Each of the 2 lakes and the junction canal has 1 permanent station from which the samples were collected. Those permanent stations are one in the 1st lake (near the tunnel), one in the 2nd lake (near the fish cages) and one in the junction canal (after the output of the fish farm). One station was added to record the quality of the original wastewater income to Rayan lakes. This new station was fixed at the 1st point receiving the water (end of the tunnel, which represents the start point of the upper lake). The 4 stations could be increased for each lake and the canal, and the mean values of the results recorded. WRPA staff collected subsurface grab water samples, once for each season from these 4 stations (December, March, June, and September). Collected water samples immediately transferred to the EEAA laboratory in Cairo to be analyzed.

Materials

- Motor boat
- 4WD car
- Plastic bottles
- Ice box
- Field sheet
- Marker pen
- EEAA central laboratory for sample analyses

The tested water quality parameters are as follows:

PARAMETER	SYMBOL	UNIT OF MEASURE
Hydrogen ion conc.	pH	Units
Biological oxygen demand	BOD_5	Mg/L
Chemical oxygen demand	COD	Mg/L
Total suspended solids	TSS	Mg/L
Total dissolved salts	TDS	Mg/L
Ammonia	NH_4^+	Mg/L
Nitrites	NO_2	Mg/L
Nitrates	NO_3^-	Mg/L
Phosphates	PO_4^-	Mg/L
Total nitrogen	TN	Mg/L
Total phosphorus	TP	Mg/L
Lead	Pb	Mg/L
Mercury	Hg	Mg/L

Cadmium	Cd	Mg/L
Manganese	Mn	Mg/L
Arsenic	Zn	Mg/L
Ferrous	Fe	Mg/L
Cupper	Cu	Mg/L
Mercury	Hg	Mg/L
Magnesium	Mg	Mg/L

II.2. Paleontology Monitoring Program

Methodology

A. Photo Monitoring

Each fossil site has been mapped, photographed and numbered. The routine patrolling is realized by EEAA researchers in the fossil area twice per week (during the weekend, when normally the area is visited by the tourists), once per month the condition of each fossil site is verified through the comparison with the photo. And once every three months to check the condition of each fossil site and to repair the broken parts of the skeletons.

The main features of the photo monitoring are the following:

Personnel: 2 rangers, 1 community guard and 1driver

Equipment: 4X4 car, digital camera, GPS, data sheets, pencil, compass, the file of the fossil photos.

Frequency: once per month

B. Fossils Sits Description and Repairing

The procedure that has been used to repair the fossils is following:
- Removing the sand from the fossils;
- Looking for all the skeleton's components;
- Cleaning the fossil constituents.
- Mending the broken parts of the skeleton.
- Painting the fossil component with a hardener substance (polyvinyl acetate).
- Arranging the different parts of the skeleton in the right position and detecting the missing ones.

Personnel: 1 researcher (geologist), 1 researcher trained on fossil repair methodology, 2 community guards

Equipment: 1 pale, 2 brushes, polyvinyl acetate, glue Vinavil

Frequency: every three months and when needed

III. Economic Activities Monitoring

FIRST: Site Inspection

Waste Monitoring Methodology

personnel	Equipment	Frequency	Object
2 Ranger	Data Sheet	Every 3 months	Control of landscape pollution

Human activities inside WRPA:

1- Oil Extraction
2- Land reclamation
3- Intensive fish farm
4- Fish cages
5-Pump Station
6- Ice Factory
7- Police Station
8-Coptic Monastery
9- Cafeterias & Safari Camp

Data Collection System:

We always go to the **Human Activity Site** and asking the people there (whatever owners or workers) about the waste treatment system they used, we record all of this data they tell us on the specific data sheet, then we inspect the site to make a comparison between what they said and the fact. The specific data sheet includes the following:

DATA SHEET FORM.

Date	Type of activity	Collection (Y/N)	Treatment	Frequencies of treatment	Recycling	Landscape pollution	Comments

SECOND: Photo Monitoring and Site Plan Realization

Methodology

personnel	Equipment	Frequency	Object
2 Ranger	GPS, camera	Every 6 months	Point out and locate the new infrastructures.

Work System:
We go to the activity site, we pick photos for the entire site to find out if there are any new infrastructures, and of course in case of existing new infrastructures we take the points with the GPS.

TYPE OF ACTIVITIES:
The same listed in the first section.

NOTE:
The photo monitoring of the economic activities is under realization and no modifications to the original infrastructures has been produced **except in 4 economic activity sites, Oil extraction - Land reclamation - Safari camp - Coptic monastery.**

4.2.3. Documenting

- Monitoring reporting

- Management reporting
- Progress reporting
- Updating of all zone maps

4.3. SPECIFIC ACTIONS

4.3.1. Zone A: Special Protection Zone

Fossil Area (Wadi El-Hitan)

Natural Resources Management

Actions

General

Periodical Fossil and paleontological monitoring will be acting throughout the year in the way that discussed above.

Normal patrolling will follow the pre-mentioned system. 3-day patrolling or camping system will be followed. The normal procedure of law enforcement will be applied against any violation.

Group visits will be done after having authorization from NCS/EEAA and WRPA and under the complete control of the protected area staff.

Specific

The area of this zone is sensitive enough towards the uncontrolled sorts of exploitation or eco-tourism. The staff of the protected area together with outside specialists will produce a site plan for developing the area from the eco-tourism point of view parallel with the education and conservation purposes.

Site plan

The plan depends mainly on a well-organized infrastructure and staff system that ensurs the suitable control of the area and optimum protection for the natural and cultural wealth of the amazing enormous number of fossilized whale skeletons.

Outpost (HQ for WRPA, inside the valley)

The outpost will be mainly established for the permanent existence of WRPA staff inside the zone. 6 guards in shifts will be in charge for permanent stay in the area. 2 environmental researchers will supervise and ensure the smooth flow of activities.

Checkpoints (Inside the valley)

Located at the start- and endpoints of the valley are the two checkpoints. They will ensure application of the area rules and deal with the possible violations and violators via their communication and transport equipment.

Parking and Camel resting sites (outside the valley)

The two places, joined with WRPA checkpoints, will be designated for vehicle parking outside the valley. From these sites a visitor can decide whether to make his tour using camels or on foot.

Ecolodge (outside the valley)

A private sector will invest in designated area, just outside the valley, for an ecolodge serving the clear eco-tourism purposes.

Open Air Museum

A definite area had been selected to establish the open air museum inside Wadi El-Hitan Valley. The most integral whale skeletons will be selected to keep inside glass containers in their natural habitat.

Public Use

Rules

The proposed outpost and checkpoints with the relevant WRPA staff will ensure the application of the general rules of the area.

Public Awareness and community outreach

The program is including targets mainly outside the protected area which are represented in the local and foreigner visitors.

To develop a strategy plan for environmental education and awareness in WRPA, the Land Reclamation, Petroleum company, cafeterias, fishermen, and monks has to held for a several workshops about WRPA.

More than 150,000 visitors visit WRPA each year more than 95% of them are Egyptians. Most of visitors being in the beach area, a few number being in the fossil area and south of the 2nd lake (usually foreigners). In order to manage the visitors inside different zones, WRPA staff cerate a special kind of monitoring based on the type of the zone.

4.3.2. Zone A: Strict Natural Zone

Spring and Rowayan Areas

Natural Resources Management

Monitoring program for different biotic elements had been developed and modified to be more efficient. Two types of biodiversity monitoring are operating inside this zone which are: vegetation monitoring & mammal monitoring

Public Use

The only sort of human presence in this area is the Coptic monastery with the monks. An agreement form had been done between the monks, as an essential stakeholder, and the protected area staff since 2001. The agreements were including specific rules have to be operated and respected from the side of the monks in collaboration with the WRPA to protect the area. The coming actions are going to be acted:

- The application and operation of those rules are going to be monitored by the ranger responsible for economic activities monitoring.
- The ranger has to provide a monthly report about the degree of application of these rules and has to report any violation noticed or stated by any of other acting staff of WRPA.
- A simplified form was designed to report the degree of the application of the protected area rules by the Coptic monastery members.

Specific rules were appointed to protect the natural resources inside the areas of this zone.

Public Awareness and community outreach

The public awareness program in this zone has only one target and should be directed for the monks of Coptic monastery. The program must involve different communication channels between their side and that of the protected area, identifying what is new for both and what are the different means to support the collaboration of the different programs of the protected area as the monitoring program.

The public awareness should be considered as crucial to reach the following main objectives:-

- Promoting WRPA as a valuable and educational area.
- Creating communication channel between the monks and WRPA.
- Identifying the mean of protected area (mahmia), its importance, rules and the meaning of special zone.
- Involving the monks in conservation and different monitoring especially in mammals and birds.

To achieve this objectives:-

- lectures
- Regular meeting (4-monthly meetings)
- Posters
- Pamphlets
- Training about the monitoring of mammals, plants, geology and the birds.

4.3.3. Zone B: Reserve Protection Zone

The Area South of the Lower Rayan Lake and the fourth spring

Natural Resources Management

The normal patrolling and Biodiversity monitoring programs are acting throughout the year ensuring the right protection of the place.

Bird monitoring, mammal monitoring and vegetation monitoring programs are partly operating seasonally in this zone. The no-fishing area will be demarcated.

Public Use

Patrolling and monitoring activities will ensure the application of the rules inside the area of this zone. The bird watching sites and the foot-path will be maintained

Public Awareness and community outreach

The primary target of the program in this zone is the local communities of the main villages surrounding the protected area and the fishermen as a sub-target. The protected area roles have to be forced down to this target. The program must involve the concept of the protected area parallel with the collaborative management issues.

It's the most important zones inside WRPA because its works as a window to the world.

The public awareness should be considered as crucial to reach the following main objectives:-

- Showing the importance of the fossil area as world heritage site.
- Showing the importance of the south of the 2nd lake as a bird watching site.
- Promoting WRPA as a valuable recreational and educational area.
- Making regular tourist monitoring inside fossil area.

To achieve this objectives:

- Information panels
  (3 information and education panels were needed for the different zones of the fossil area)
- Posters
- Pamphlets

4.3.4. Zone C: Recreational Zone

The Area of Rayan Lakes and their Destinations

Natural Resources Management

The natural resources in this zone are directed to the purposes of eco-tourism under the protection of the law 102/1983 by the WRPA staff. Monitoring programs for vegetation, mammals, birds, fish and water quality are acting through the whole year as described earlier.

No more investment for the natural resources in the area of this zone is allowed except for the planned eco-tourism spots.. WRPA eco-tourism facilities (camping site, bird watching sites, tracks and signposts) will be partly renewed to ensure a satisfactory visitor use.

WRPA education facilities (visitor center, brochures and posters..etc. and different information facilities) will support enough awareness of with the resources of the area

Public Use

Two sorts of public use are acting inside this zone, which are the ecotourism and economic activities.

Ecotourism

Visitor center, cafeterias, safari camp, camping site and newly provided W.C. facilities will be the acting ones to support the eco-tourism in this zone.

A detailed map for the proposed eco-tourism spots inside WRPA will be provided. The proposed ecolodges will be done according to the study of El-Kammash, 2001. The study was prepared and presented to the EEAA/Egyptian Italian Project of WRPA. The specifications of the eco-tourism facilities will follow the previous study and the rules of the designated zone inside WRPA. (Figure 2).

Economic Activities

The traditional fishing activities as well as general pathways for the traditional fishermen around the lakes are the operating activities inside this zone. An efficient patrolling system is the main way ensuring the control of these activities.

Patrolling and law enforcement will ensure the application of area rules

Public Awareness and community outreach

The primary targets of this program have been identified as local communities around the protected area and the local and international visitors (outside the PA). Fishermen and owners of economic activities (inside the PA) are representing sub-targets. The main visitor area (waterfall area) is included in this zone.

The public awareness should be considered as crucial to reach the following main objectives:-

- Creating communication channel between the fishermen and WRPA.
- Identifying the mean of protected area (mahmia), its importance, and rules.
- Improving the visitor center.
- Making regular visitors monitoring.
- Creating communication channel among WRPA, schools & universities.

To achieve this objectives:-

- Regular meeting with fishermen. (4-monthly meetings)
- lecture s
- Posters
- Pamphlets
- Establish permanent office inside the visitor center with a computer.

4.3.5. Zone D: General Use Zone

Spots of intensive economic activities around Rayan Lakes

Natural Resources Management

The management plan has developed strong and effective rules ensuring the sustainability of the area natural resources within the investment areas of this zone. The existing economic activities are subjected to obey these rules. In order to increase the applicability practices of these rules the WRPA staff held several meetings with the related stakeholders on the local level on the preparation period of WRPA management plan. The Governor has been supported the management plan and the collaborative management strategy of the protected area to keep the sustainability of natural resources. The monitoring system of the biotic and abiotic elements of natural resources of the area is supporting the collaborative management system to produce a sound management strategy for natural resources.

Public Use

Eco-tourism, economic activities and human settlement are representing the three forms of public use that currently existed within the areas of this zone. The existing economic activities are fully under licence of the EEAA either on an institutional level e.g. Oil extraction and land reclamation programs (according to prime-ministerial or ministerial agreements) or on the level of NCS/EEAA e.g. fish farms, fish cages, cafeterias.

Actions

- The monitoring program for the existing economic activities will be continued.
- No more economic activities will be accepted inside the protected area for two reasons: 1) the area percentage of economic activities inside the protected area is now reaching almost 10% of the total area of the protected area, and according to the prim-ministerial decree, the percentage of the activities must not exceed 10% of the total area of the protected area & 2) the monitoring program showed that the activities should have no more expansion to ensure the integrity of the ecosystem inside WRPA.

The Normal patrolling activities and monitoring of economic activities will ensure the right use of the area:

Public Awareness and community outreach

The program has many targets identified inside the protected area, as follows:

Land Reclamation

- Creating appropriate communication channel between WRPA management and the settlements.
- Collaboration with them, helping the WRPA management in a different tasks according to our program, present enough information about the value and the benefit of bio-agriculture, raising the level of public awareness for schools to create new generation able to help us in a good way.

- Identify the needs of the settlements.

To achieve this objectives:

- Regular meeting with settlements (3 meetings)
- Festival
- Trips for school children & for the settlements according to our facilities (3 Trips)
- Establish permanent office inside land reclamation
- Posters
- Pamphlets

Oil Company & Aquacultures

- Identifying them with the effective of their activities for WRPA.
- Making targets of environment education and awareness program by WRPA staff.
- Improving the accountability of licenses holders operating inside WRPA.

To achieve this objectives:-

- Regular meeting with settlements (4-monthly meetings)
- Work shops
- lectures
- Posters
- Pamphlets

PART 5
5. Management tools

The long-term application of the management strategy is being achieved through using the following management tools; monitoring and research, GIS and remote sensing, EIA, environmental regulations and law enforcement and documenting.

The tools are described in the management plan.

RECOMMENDED RESEARCH PROJECTS

Zone A: Special Protection Zone

- Visitor use and education plan for the fossil area (Wadi El-Hitan).

Zone A: Strict Natural Zone

- Study of captive breeding or reintroduction possibilities for the dorcas gazelle in WRPA.
- Study of the main environmental correlations between the vegetation and environment inside the area. (for future management of the area).

Zone C

- Study of the maximum discharge limits for the elements on the water of Rayan Lakes. (water quality, hydrology)
- Study of the carrying capacity of the lakes for more fisheries investment.
- Establishing of the center for Migratory Bird Studies

PART 6

6. MANAGEMENT RESOURCES

The critical resources for the management of WRPA can be identified under three main categories, which are infrastructure and equipment, financing and staffing. The resources are described in the management plan.

6.1. INFRASTRUCTURE AND EQUIPMENT

The proposed equipment for the next three years is suggested below, (Table 2).

Table (2) Suggested needs of equipment and field tools

Equipment	Number
Vehicles	
4WD Cars	4
Motorbikes	3
Radio Station	
Basic unit	6
Mobile Walki-Talkie	10
Scientific and Field Supplies	
GPS	3
Personal computers with complete accessories	4
Laptop	2
Weathering station	1
Water Quality Control Lab.	Standard
Digital camera	2
Video camera	1
Camera trap system	2
Binoculars	15
Telescope	3
Complete housing furniture of the existing management infrastructures	

6.2. FINANCING

The total proposed budget of the second phase of WRPA project is 6,024,000 L.E. until December 2005 shared with the NCS/EEAA.

WRPA project: budget		Expenditure (L.E.) July 2003 - June 2004					
Code	Budget Items						
	[illegible]						
1.1	International TA						
	Co-manager / Technical Advisor	m/m	12	23.500	282.000		282.000
	Support to CM agreements	m/m	0.5	33.000	16.500		16.500
	Ecotourism and marketing	m/m	0.5	33.000	16.500		16.500
	Information, Education, Communication	m/m	0.5	33.000	16.500		16.500
	Biodiversity Monitoring & Evaluation	m/m	0.5	33.000	16.500		16.500
	Design of open-air museum	m/m	1	33.000	33.000		33.000
	International Travel	n	5	3.300	16.500		16.500
	TOTAL INTERNATIONAL TA	m/m	*15*		397.500		*397.500*
1.2	National TA						
	Infrastructure	m/m	3	15.000	45.000		45.000
	Legal / Institutional	m/m	1	15.000	15.000		15.000
	Ecotourism	m/m	1	15.000	15.000		15.000
	Information, Education Communication	m/m	1	15.000	15.000		15.000
	Collaborative management	m/m	2	15.000	30.000		30.000
	Unallocated	m/m	1	15.000	15.000		15.000
	TOTAL NATIONAL TA	*m/m*	*17*		135.000		135.000
	TOTAL TA				**270.000**		**270.000**
	[illegible]						
2.1	**Project Expenditure.**						
2.1.1	Camp & Outposts Operating Expenses	m	12	3.500	18.000	24.000	42.000
2.1.2	Office & Scientific Expenses	m	12	1.500	6.000	12.000	18.000
2.1.3	Visitor Centre Operating Expenses	m	12	1.000		12.000	12.000
2.1.4	Vehicle operating expenses	lump	1		30.000	60.000	90.000
2.2	**WRPA Personnel**						
2.2.1	Allowances existing EEAA staff	m	12	4.600	55.200		55.200
2.2.2	Ticket collectors (2)	m/m	24	0.600	14.400		14.400
2.2.3	Accountant	m/m	12	1.700	20.400		20.400
2.2.4	Community guards (n.6)	m/m	72	0.500	36.000		36.000
2.2.5	Support staff (n. 2)	m/m	24	0.600	14.400		14.400
2.2.6	Local travel	lump	1	4.000	4.000		4.000
	TOT. OPER. & MAINT.				198.400	108.000	306.400

3.1	Fossil Area Outpost	lump	1	150.000		150.000	150.000
3.2	PAMU staff accommodation facilities	lump	1	500.000		500.000	500.000
3.3	Tracks and signposts	lump	1	30.000		30.000	30.000
3.4	Environmental school	lump	1		200.000	220.000	420.000
3.5	Upgrading Eco-centre	lump	1	15.000	15.000		15.000
3.6	Ecotourism facilities	lump	1	25.000		25.000	25.000
3.7	N.3 Vehicles	n	1	225.000	125.000	200.000	325.000
3.8	N.3 Motorbikes (off-road 250cc)	n	2	15.000	15.000	15.000	30.000
3.9	N.6 Camels	n	6	6.000	20.000	16.000	36.000
3.1	Communication equipment	lump	1	67.000	67.000		67.000
3.11	Scientific & office equipment	lump	1	50.000	50.000		50.000
3.12	Field equipment	lump	1	30.000	30.000		30.000
	TOT. EQUIP. & SUPPLIES				**522.000**	**1156.000**	**1678.000**
	ACTIVITIES						
4.1	Training and production of manuals	lump	1	150.000	150.000		150.000
4.2	Support to CM agreements	lump	1	50.000	50.000		50.000
4.3	Ecotourism and marketing	lump	1	50.000	50.000		50.000
4.4	Information, Education, Communication	lump	1	100.000	100.000		100.000
4.5	Support to Wadi Hitan Initiative	lump	1	25.000	25.000		25.000
4.6	Support to EEAA Fayoum local office	lump	1	100.000	100.000		100.00
4.7	Monitoring, evaluation and research	lump	1	25.000	25.000		25.000
	TOTAL ACTIVITIES				500.000		500.000
	GRAND TOTAL				1490.400	1264.000	2754.400

Encouraging and supporting the program of organic agriculture in the land reclamation scheme inside the protected area. Eco-label (organized and done by WRPA management unit) can be attached to the harvest, which can guarantee high income. WRPA can then have a reliable financing source from these returns.

6.3. STAFFING

The current status of WRPA staff is as the following:

JOB	NUMBER
Protected Area Manager.....(PAM)	1
Environmental Affairs Researcher (ranger) .....(EAR)	9
Legal Affairs Officer .....(LAO)	1
Accountant.....(Acc)	1
Financial Affairs Officer.....(FAO)	1
Ticket Collector.....(TC)	3
Guards.....(Gd)	7
Secretary.....(Sec)	1
Driver.....(Dvr)	2
Supporting Staff (House watching).....(SS)	2

The entire staff is lacking of the permanent recruitment by EEAA except the protected area manager and the two drivers. Table (3) shows the name, title and specific tasks for each of the management staff.

Table (3) Current profile of WRPA staff

Name	Title	Specific tasks
Hossam Kamel	PAM	General coordination
Zakaria	Acc	Accounting
Mohamed Mayhoob	FAO	Financial Affairs
Arafa El-Sayed	EAR	Coordinator of public Awareness program
Mohamed Ismail	EAR	Coordinator of Ecotourism program
Wed A. Latif	EAR	Coordinator of Biodiversity Monitoring
Mohamed Talaat	EAR	Coordinator of Manegement & Effectiveness Monitoring /vegetation monitoring / water quality & fish farms monitoring
Haitham Nabeeh	EAR	Biodiversity monitoring
A. Nasser Yasen	LAO	Legal Affairs
Mohamed Sameh	EAR	Geology and Paleontology monitoring
Mohamed Ali	EAR	Water Quality
Mohamed Effat	EAR	Spring area/Fish monitoring
Walid Ahmed	EAR	Public awareness/Visitor center
Mohamed A. Mola	Gd	Guarding/HQ
Mohamed Hussin	Gd	Guarding/visitor area

Mohamed Saleh	Gd	Guarding/spring area
Ali Ahmed	Gd	Guarding/boat driving
Mefreh Nagi	Gd	Guarding/car driving
Essam Mohamed	Sec	Secretary
Hamdy A. Sattar	Gd	Guarding/spring area
Nadi	Gd	Guarding/visitor area
Reef Allah A. Saleh	Gd	Guarding/spring area
Nafaa A. Mohsin	Dvr	Driving
Mohamed Abbas	Dvr	Driving
Musa A. Musa	TC	Ticket collection
Helmy Mohamed	TC	Ticket collection
Husni A. Wahab	TC	Ticket collection

For establishing of more stable management staff inside WRPA, the following actions need to be implemented:

- Permanent recruitment of the entire skeleton of the staff, to ensure the long-term sustainability of WRPA management staff.
- Ensuring the long-term permanence of the staff by supporting the establishment of a stable social life for the staff coming from outside Fayoum area.
- Offering by EEAA of additional money (for the staff coming from outside Fayoum area) to facilitate and make ease for overcoming the additional living loads as communications, transportation, health care, etc.
- Offering the long-term and international high level training to support the capability of the staff for the collaborative management and make strength of the management abilities of the staff. The staff with high management abilities will be able to manage the proposed network of protected areas especially those of similar habit as Siwa and White desert protected areas of the Western desert of Egypt.

❖ Recruitment of following human resources

Job Description	Number	Specialization
Environmental Affairs Researcher	4	Bachelor degree
Guard	8	Preferred with diploma degree
Ticket Collectors	3	At least diploma degree

Duty hand book for WRPA staff

❖ Handbook of the duties of the researchers has been finished and will be implemented.

❖ Participation of the key staff in the preparation and application of the national strategy and planning of the protected area. A smooth continuous communications among the key staff, NCS and other stakeholders (inside and outside Fayoum

governorate and other authorities) is a must, ensuring a strong and effective full-time collaboration among all involved sides.

7. Implementation of the second Phase of the EIEP Project.

In 2003 is foreseen the initialisation of the second phase of the Egyptian Italian Environmental Program (EIEP), WRPA project.

MONITORING REPORT

MONITORING REPORT

ON THE THIRD YEAR OF THE MONITORING PROGRAM

WADI EL-RAYAN PROTECTED AREA

Presented by
Wadi El-Rayan Protected Area staff

Coordination & Preparation
By
Mohamed Talaat El-Henawy
M.Sc. Ecology
Senior Coordinator of Management
& Effectiveness Monitoring

JANUARY
2002

Prepared by

Task Group

Wadi El-Rayan Protected Area staff

General Coordination
Eng. Hossam Kamel
Preparation and Organization
Mohammed Talaat

GIS

Arafa El-Sayed
Mohammed Sameh

Supplementary data

by

Ahmed Eidy Ahmed	PAMU
Mohammed Mayhoob	WRPA
Arafa El-Sayed	WRPA
Mohamed Talaat	WRPA
Wed Abdel Latif	WRPA
Abdel Nasser Yaseen	WRPA
Mohamed Sameh	WRPA
Haitham Nabeeh	WRPA
Mohammed Ali	WRPA
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Mohamed Effat	WRPA

Technical Assistant
Cosimo Tendi, IUCN

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Dr. Dick Parris
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CONTENTS

EXECUTIVE SUMMARY

Wadi El Rayan Protected Area (WRPA), situated in the Fayoum Region of the Western Desert of Egypt, has been declared by prime ministerial decree N. 943 in 1989.

The current work is the third report on the monitoring activities and introduced by WRPA staff. More advanced and organised presentations of monitoring activities had introduced by WRPA personnel, each in his field. The author did the overall presentation and reporting of this work. The third year of the monitoring activities inside WRPA was organised mainly and practised by WRPA staff after the ending over of the 1st phase of the Egyptian-Italian project with reduced presence of the Italian side at the interface period (the time of this work). The report included the following:

Introduction, including the basic information, specific aims and total achievements.

Mapping, Topographic, infrastructure and habitat & land-use maps were produced and their continuos updating are presented.

Biodiversity monitoring, including the different practices and methodologies applied and the results interpretation of the third year of scientific monitoring programs of WRPA. These programs included the available aspects of biodiversity as vegetation, birds and mammals.

Resource and Environmental monitoring, including the methodologies, results and assessment of the natural resources. Monitoring of geology and pleontology, aquatic resources (water quality of the 2 lakes), the economic activities inside the

WRPA and their impacts on the environment of the protected area and visitor monitoring were provided in this part.

THIS REPORT about the third year of the monitoring program has introduced by WRPA research officers (rangers) who became reliable source of collecting and presenting data and be able to evaluate and stand on the proper way to keep the protected area well organized and managed.

PART I

1. INTRODUCTION

1. INTRODUCTION

1.1. Background

Wadi El Rayan Protected Area has been declared by prime ministerial decree N. 943 in 1989 according to Law No. 102/1983 of the protected areas. The protected area, covering 1759 km² as a part of Fayoum Governorate, south-west of Cairo.

1.2. Location and geomorphology

Wadi El-Rayan occupies a depression in the northern part of the western desert of Egypt, situated between longitude 29°00' 00" & 29° 24' 11" E and latitude 30°00' 00" & 30° 34' 00" N. Wadi El-Rayan protected area located 210 km right angle south to the Mediterranean coast at co-ordinates of 30°00' N & 30°18' E, (Figure 1). The deeper portion of the depression is occupied by 2 man-made lakes connected by 3-4 km long channel. Other water supplies are present as the underground water, and 4 natural sulphured water springs.

The two lakes were created (in the seventies) in the lower portion of Wadi El Rayan sub-depression to channel out excess agricultural drainage water in order to slow-down the increase of the water-table in the Fayoum main depression and in Qarun lake. The creation of a large body of water in this hyper-arid area had a striking ecological impact: new species of plants, mammals, birds and invertebrates moved to Wadi El Rayan area. (IUCN, 2000a)

1.3. Climate

The climate is typically Saharan, hot and dry with scanty winter rain and bright sunshine throughout the year. The area is hyper-arid with mild winters and hot summers (Zahran, 1989). The annual average of the precipitation rate is 10.1 mm. The highest rainfall occurs in December (40 % of annual rain) and the lowest (0%) in August. The average ambient relative humidity is 51%. The direction of the wind is, for most of the year, from the North, varying North-West or North-East, After Saleh, (1988).

Table: Summary of the monthly means of 50 years of temperature records (Saleh, 1988)

TEMPERATURE VALUES	WINTER	SUMMER
Mean	13.7°C	28.5°C
Absolute minimum/maximum	-1.2°C	48.8°C
Mean amplitude of diurnal fluctuations	14.2°C	17°C

Monitoring status and trends in biodiversity resources and the performance of management activities, is increasingly recognised as an essential tool for planning and implementation of biodiversity conservation and sustainable development (WCMC, 1996). The establishment of a comprehensive monitoring system was proposed in the overall work plan as a crucial tool supporting the planning and the management of the protected area (IUCN, 1998a). On January 1999 the IUCN designated technical assistant for the monitoring programme of WRPA, who actively worked and introduced two reports on WRPA monitoring activities.

1.4. Main Purpose of this report

This report is currently presented to:

- Stands on the real situation of the natural resources of the protected area, as a proper task of protected area management.
- Describe the progress had been done for the methodologies applied during the last 2 years of the monitoring programme.
- Realise the applicability of the improved methods to monitor the resources of the protected area, supported by well-presented results, comments and recommendations.

The monitoring activities are carrying out by WRPA personnel, as a part of their routine assignments, under the co-ordination of the 2 senior co-ordinators of management and biodiversity monitoring (WRPA staff), the technical assistant (Italian co-operation) and the WRPA director.

MAPPING FOR WRPA

2. MAPPING

By
Arafa El Sayed Amin
Senior Coordinator of communication with local stakeholders and public awareness program, WRPA.

The GIS software program **MapInfo ver. 4.5** was used to produce the mapping work for WRPA. The Protected Area Management Unit (PAMU) representing in the technical assistant from the IUCN and Italian cooperation with WRPA personnel were working since 1998 to produce the maps for WRPA.

The raster map in scale 1:100 000, printed in 1960 by the American Gro Naqb and reprinted by the Military Survey Management in 1995 has been used as a basis for the topography digitalisation.

The land use map has been realised starting from the satellite photos (Tm 752, 1992-1998) and adding any small spot of vegetation through the field data collection, using the GPS.

Any activity or changes in the infrastructures, roads or tracks have been located using the GPS and then transferred in the digitised map using Map Info.

This report introduces the last versions of WRPA maps, which have minimum or no changes for the past year. They are as follows:

1. Topographic map for WRPA, scale 1:100 000 (Figure 2),
2. Updated infrastructure monitoring map, scale 1:100 000 with the present status of roads, tracks or buildings in WRPA (Figure 3) &
3. Habitat and land use map of WRPA, scale 1:100 000 (Figure 4)

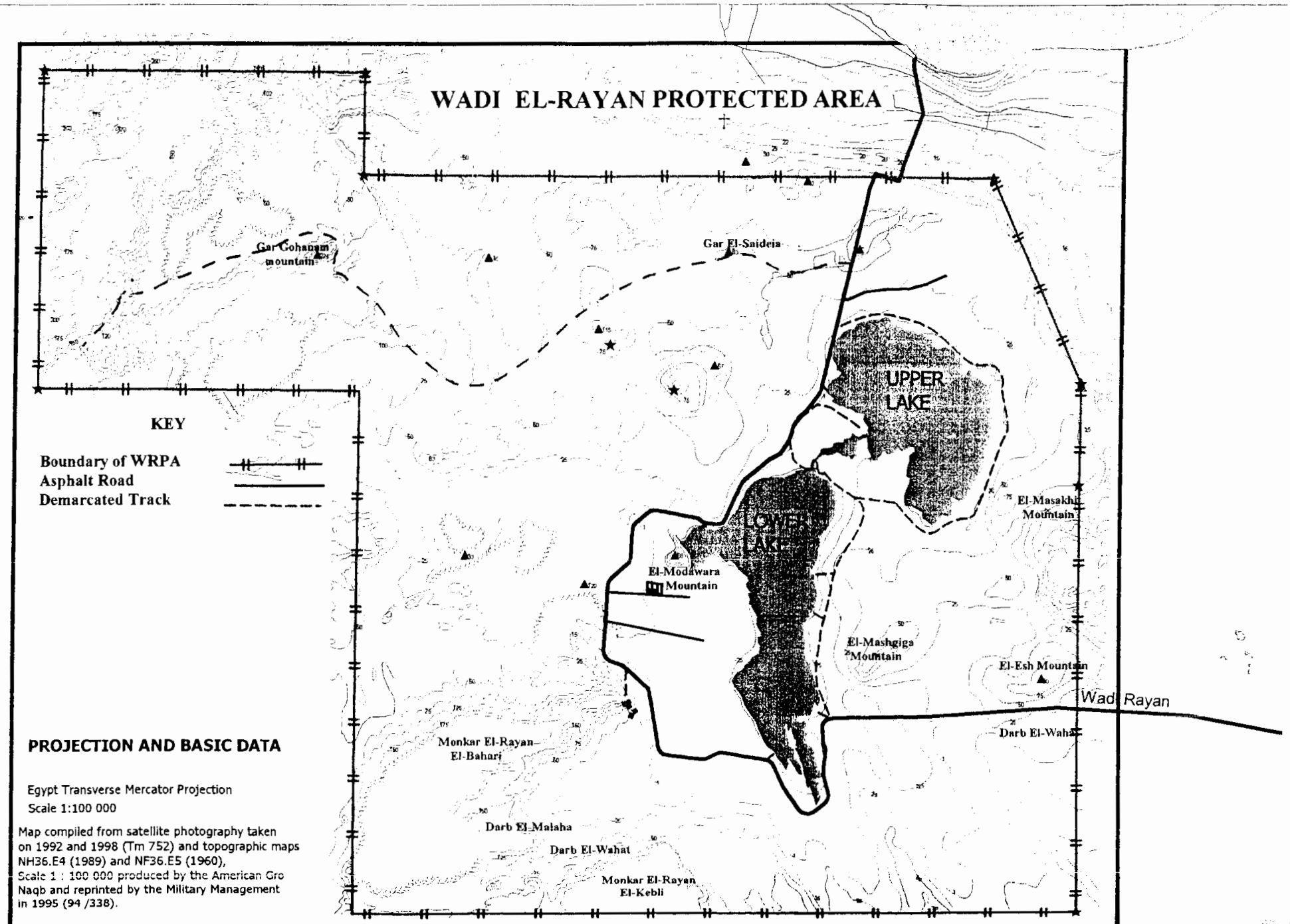

FIG. 2. WRPA TOPOGRAPHIC MAP

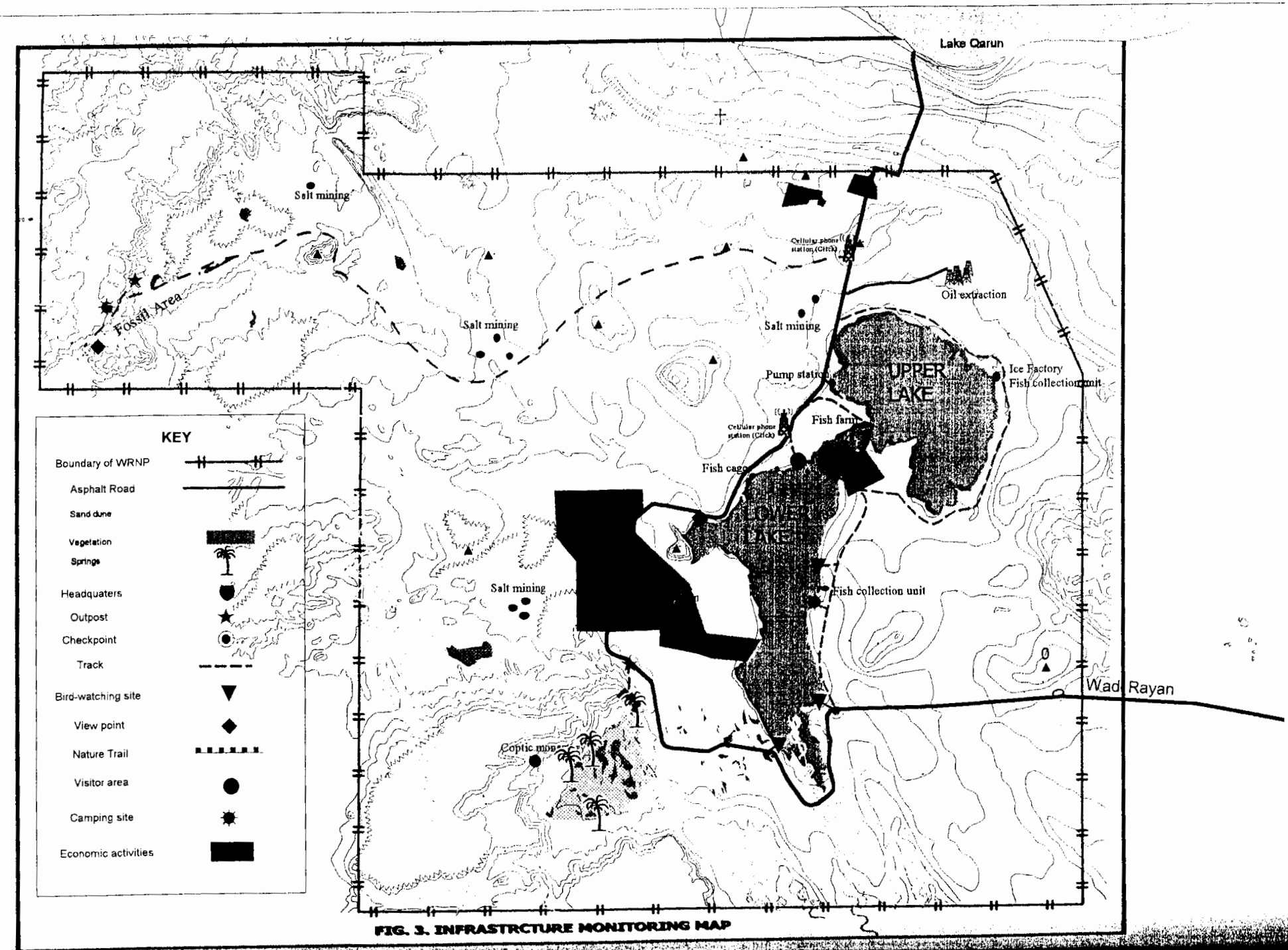

FIG. 3. INFRASTRCTURE MONITORING MAP

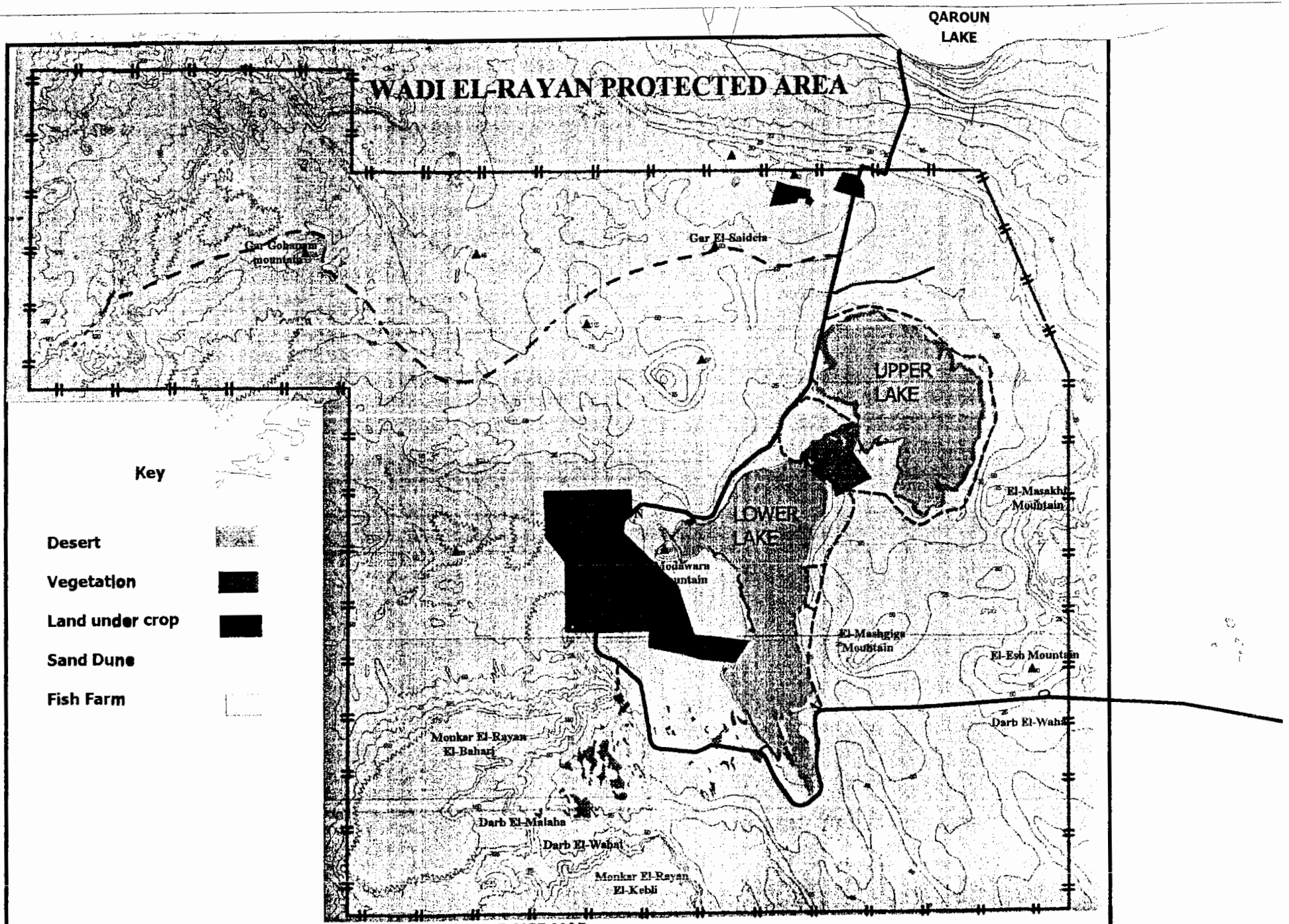

FIG. 4. WRPA LAND USE MAP

PART III

3. BIODIVERSITY MONITORING

3.1. VEGETATION

3.2. BIRDS

3.3. A. MAMMALS

3.3. B. GAZELLES SURVEY

3. BIODIVERSITY MONITORING

According to the time and human resources restriction, the biodiversity monitoring has been focused on the aspects of the WRPA biodiversity which have not been extensively considered in the previous studies: the terrestrial and aquatic invertebrate population (Annexes 1&2), as well as the reptiles one (Annex 3) have not been included in the monitoring program because already investigated in the last 10 years (see IUCN, 2000). Fish monitoring report had not been completed until the moment of introducing this report, so only a realized fish species list is provided in this report by WRPA staff (Annex 4)

BIODIVERSITY UNIT OF WRPA

For the proper monitoring of biodiversity inside WRPA, Biodiversity Unit had been established after the permission from Nature Conservation Sector, EEAA. Three senior rangers are directing the primary activities of the unit. The names and qualifications of these rangers are:

- **Name:** *Wed Abdel Latif Ibrahim*
  Degree: B.Sc. Environmental Science, finishing his master on the same field.
  Duty inside WRPA: Senior Coordinator of Biodiversity Monitoring.

- **Name:** *Haitham Nabeeh Bedeer*
  Degree: B.Sc. Environmental Science, finishing his master on the same field.
  Duty inside WRPA: Senior, Biodiversity monitoring

- **Name:** *Mohamed Talaat El-Hennawy*
  Degree: M.Sc. Plant Ecology / Fresh Water Ecology, B.Sc. Botany.
  Duty inside WRPA: Senior Coordinator of Management and Effectiveness Monitoring

The members directing the unit of biodiversity did the reporting of biodiversity monitoring. The specific needs and recommendations were simply introduced at the end of biodiversity monitoring part of this report.

VEGETATION MONITORING FOR WRPA

MONITOPRING REPORT

WINTER 2001

3.1. VEGETATION MONITORING FOR WADI EL-RAYAN PROTECTED AREA

By
Mohamed Talaat El-Hennawy
M.Sc. Plant Ecology - Fresh Water Ecology -
Senior Coordinator of Management and Effectiveness Monitoring

3.1.1. INTRODUCTION

WRPA is located at the western desert of Egypt, and is simply classified under the Oasis and Depression part of the western desert, Zahran (1989). The climatic conditions of Wadi El-Rayan depression are arid one: high temperature, low humidity high evaporation and rainfall is negligible. The artesian underground water is the main water resource of the area. Xerophytes, halophytes and hydrophytes are the main vegetation types recognized in WRPA. These plant communities were found to be distributed among different types of natural habitats. These habitats were represented in: 1) *Reed swamp habitats*, 2) *Salt marsh ecosystem*, 3) *Sand formations and sand dune ecosystem*, 4) *Gravel and nummuletic desert ecosystem* and 5) *Aquatic ecosystem*.

3.1.2. LOCATION AND GEOMORPHOLOGY

Wadi El-Rayan occupies a depression in the northern part of the western desert of Egypt, situated between longitude 29° 00' 00" & 29° 24' 11" E and latitude 30° 00' 00" & 30° 34' 00" N. Wadi El-Rayan protected area located 210 km right angle south to the Mediterranean coast at coordinates of 30° 00' N & 30° 18' E. The deeper portion of the depression is occupied by 2 man-made lakes connected by 3-4 km long channel. The main supply of water other then the 2 lakes is underground water, and 4 natural sulphured water springs.

3.1.5. MATERIALS AND METHODS

3.1.5.1. Sampling program

Stratified Sampling methods were used that the vegetation is divided up before samples are chosen according to variations within the vegetation communities, on the basis of difference in vegetation structure and variation in dominant species.

Five main terrestrial habitats were selected as the study area for the monitoring program in which sampling sites were selected to cover five main natural habitats all over WRPA.

A total of 12 stands were selected to represent the variations in the vegetation communities inside the area. The stands were distributed among the main important sectors of the protected area as explained by the table:

SECTOR	NO. OF STANDS
Fossil Area (FA)	2
Upper Rayan Lake (UL)	2
Lower Rayan Lake (LL)	2
Spring Area (SA)	5
Rowayan Area (R)	1
TOTAL	**12**

The abundance of each plant species in each stand (Line intercept method) was estimated during the period from 1st Nov. to 8th Nov. 2001

The area of each stand was determined as 100 m^2.

Species identification and species names were according to Täckholm (1974) and Boulos (1995), and mainly identified through the herbarium of WRPA.

3.1.5.2 Sampling Methods

The vegetation cover was estimated on the bases of mean absolute cover of certain sp. inside the 100 m^2 area of each stand. The quadrate was divided into 10 tapes of 10 m long for each. The value of absolute cover of certain sp. was

3.1.5. MATERIALS AND METHODS

3.1.5.1. Sampling program

Stratified Sampling methods were used that the vegetation is divided up before samples are chosen according to variations within the vegetation communities, on the basis of difference in vegetation structure and variation in dominant species.

Five main terrestrial habitats were selected as the study area for the monitoring program in which sampling sites were selected to cover five main natural habitats all over WRPA.

A total of 12 stands were selected to represent the variations in the vegetation communities inside the area. The stands were distributed among the main important sectors of the protected area as explained by the table:

SECTOR	NO. OF STANDS
Fossil Area (FA)	2
Upper Rayan Lake (UL)	2
Lower Rayan Lake (LL)	2
Spring Area (SA)	5
Rowayan Area (R)	1
TOTAL	**12**

The abundance of each plant species in each stand (Line intercept method) was estimated during the period from 1st Nov. to 8th Nov. 2001

The area of each stand was determined as 100 m^2.

Species identification and species names were according to Täckholm (1974) and Boulos (1995), and mainly identified through the herbarium of WRPA.

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The vegetation cover was estimated on the bases of mean absolute cover of certain sp. inside the 100 m^2 area of each stand. The quadrate was divided into 10 tapes of 10 m long for each. The value of absolute cover of certain sp. was

- ***Tamarix nilotica***: more distributed inside the spring and Rowayan areas, around the 2nd lake, then at the Fossil area.
- ***Alhagi graecorum***: More distributed inside the spring area.
- ***Salsola imbricata subsp. gaetula***: More distributed inside the Fossil area.
- ***Desmostachya bipinnata***: The main occurrence was represented at the spring area.
- ***Nitraria retusa***: It was found tending to cover the spring area mainly and with less occurrence around the lower lake.
- ***Phoenix dactylifera***: It was occupying mainly the spring area and with minimum occurrence around the 2 lakes.

These species represented the state of dominance among the vegetation species inside the protected area. For each sector of the protected area the main dominant species were explained as shown in the next table:

Table (3): The main dominant plant species inside WRPA

SECTOR	SPRING AREA		FOSSIL AREA		UPPER LAKE		LOWER LAKE		ROWAYAN AREA	
Species	AC	RC	AC	RC	AC	RC	AC	RC	AC	RC
Alhagi graecorum	126.8	37	-	-	-	-	-	-	11	7
Arthrocnemum macrostachyum	-	-	-	-	++	-	-	-	-	-
Calligonum polygonoides sub. Comosum	14.4	5.9	-	-	-	-	-	-	-	-
Cornulaca monocantha	-	-	16.35	10.4	-	-	-	-	-	-
Desmostachya bipinnata	37.8	15.62	-	-	-	-	-	-	-	-
Haloxylon salicornicum	-	-	-	-	++	-	-	-	-	-
Imberata Cylindrica	+++	-	-	-	+	-	-	-	-	-
Juncu rigidus	+	-	-	-	+	-	+	-	-	-
Juncus acutus	+++	-	-	-	10.5	5.6	15	1.6	-	-
Nitraria retusa	35.6	18.6	-	-	-	-	+++	-	++	-
Phoenix dactylifera	23.3	14.8	-	-	+	-	+	-		
Phragmites australis	112	9.7	-	-	135	94.5	750	77.65	-	-
Salsola imbricata subsp. gaetula	-	-	127.5	31	-	-	-	-	-	-
Tamarix nilotica	257	13.05	60	38	++	-	200	20.8		
Zygophyllum album	4.4	8.8	-	-	-	-	++	-	++	-
Zygophyllum coccineum	+++	-	8.8	20.6	++	-	-	-	-	-

- ***Tamarix nilotica***: more distributed inside the spring and Rowayan areas, around the 2nd lake, then at the Fossil area.
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Cornulaca monocantha	-	-	16.35	10.4	-	-	-	-	-	-
Desmostachya bipinnata	37.8	15.62	-	-	-	-	-	-	-	-
Haloxylon salicornicum	-	-	-	-	++	-	-	-	-	-
Imberata Cylindrica	+++	-	-	-	+	-	-	-	-	-
Juncu rigidus	+	-	-	-	+	-	+	-	-	-
Juncus acutus	+++	-	-	-	10.5	5.6	15	1.6	-	-
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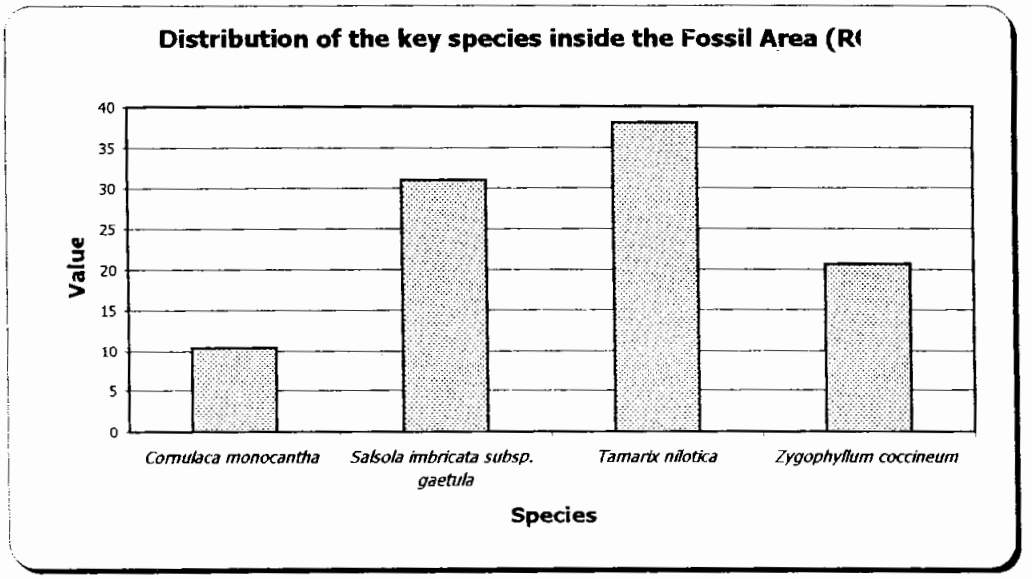
Zygophyllum album	4.4	8.8	-	-	-	-	++	-	++	-
Zygophyllum coccineum	+++	-	8.8	20.6	++	-	-	-	-	-

2. **For the Fossil Area**, the dominant sp. is *Tamarix nilotica* and then *Salsola imbricata subsp. gaetula*. *Zygophyllum coccineum* and *Cornulaca monocantha* found to be associated with the dominant species. (Figure 6). Fossil Area is the least sector of the protected area in its water supply. It also represent the place has the most characteristic and valuable geological and paleontological site in Egypt and may be all over the world.

Figure (6): Distribution of the key species inside the Fossil Area (RC)



3. **For the Upper Lake**, The dominant sp. was found to be *Phragmites australis*, the most adaptive and suitable plant species for the nature of the water in Rayan Lakes (Figure 7). The agricultural wastewater of the lakes with the range of total dissolved salts from 1300 mg/L (for the Upper Lake and the channel) to 10.000 mg/L (for some places of the Lower Lake) can be managed naturally by this plant species. This plant species can reduce the most rigorous parameters impacting the water as Suspended Solids (SS) and Biological Oxygen Demand (BOD). *Juncus acutus* was also found to be associated with *Phragmites australis* in one of the most balanced and attracting wetland ecosystems in Egypt. These wetlands support about 163 migratory and resident

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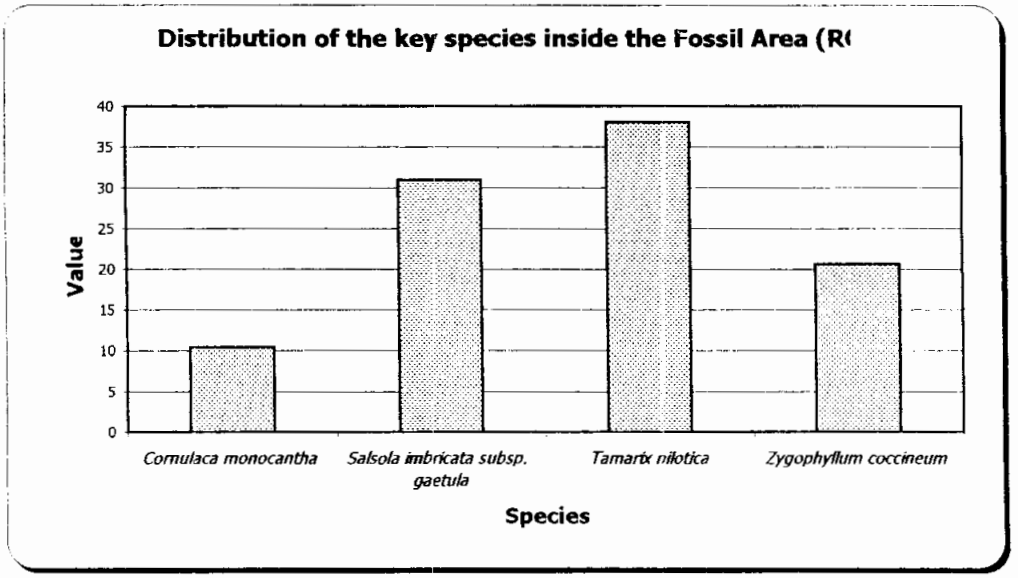

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The attached map (Figure 9) shows the distribution of sampling sites and main vegetation covers through WRPA.

3.1.7. CONCLUSION

- The majority of wild plant species in WRPA is of perennial nature. The monitoring program will be more efficient on the long term that can gives us the state of vegetation cover in the area.
- The Desert species *Alhagi graecorum* and *Nitraria retusa* are the most chracteristic species for the core zone spring area of WRPA. The wild life existence especially gazelle communities of *Gazella dorcas dorcas* inhabiting the area and depending on the 2 previous plant species which more palatable for this gazelle community.
- The vegetation patches represent the food and shelter for wild life communities that concentrated mainly in the spring area. Of the 37 wild plant species in WRPA, 14 of them was found inside the springs area supporting the presence of mammal communities as Gazelle (*Gazella dorcas dorcas*), Fennec fox (*Fennecus zerda*), red fox (*Vulpes vulpes aegyptica*), Ruppel's fox (*Vulpes ruepelli ruepelli*), Egyptian golden jackal (*Canis aureus lupaster*), African wild cat (*Felis sylvestris libyca*) and others.

3.1.8. RECOMMENDATIONS

- On the level of decision-makers, stopping the decreasing of the water level of the 2 lakes is a must. Decreasing of water level now affecting adversely the occupied area with wetlands which supports the bird and fish life of the area.
- The extension of the land reclamation areas has to stop inside the WRPA. The reclaimed areas are closely located to the spring area, the core zone of the protected area, which is put now under the threat of genetic contamination with the agricultural species. A change in vegetation community might be happened on the long term if the reclamation activities continue, making threat to the wildlife communities inside the area.

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BIRD MONITORING FOR WRPA

MONITORING REPORT

2001

BIRD MONITORING FOR WRPA

MONITORING REPORT

2001

Objectives:

1. **Updating bird check-List**
2. **Assessment of abundance and fluctuation of bird species through out the year**
3. **Identification of bird species that is difficult to identify by normal observation**
4. **Studying the migration strategies for migrant birds**
5. **Studying the status of bird species**
6. **Using the data collected in setting site plan for the area**

3.2.2. MATERIALS AND METHODS

3.2.2.1. Counting

The WRPA staff used the line transect method from the motorboat (Buckland *et al.*, 1993) for counting of the most common species of water birds along fixed transects in the Upper and Lower Lakes.

Personnel: team of two persons (trained in bird identification)

Equipment: compass, GPS, binoculars, pencils and data sheets.

Frequency: Each of the transect is walked twice at quarterly intervals within a defined two-week period, during the first half of the morning.

Method: The selected transects were located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the birds in WRPA (stratified sampling). Each transect is 1 Km length and the motorboat is driven at constant speed of about 3 Km/hour. The observers record the species, the direction and the distance of each bird resting on the lake or feeding in a place. For species that occur in flocks, they treat the flock as a single detection and record the flock size. The position recorded for a flock is the "center of gravity" of the flock, not the closest point of the flock to the observer. The flying birds are recorded and analyzed separately: whenever a flying bird (or flock) is detected, the observer wait until it comes abeam of the boat and only then he records its position.

3.2.2.2. Ringing

The method used for bird ringing was conducting following the standard of SEEN program (SE European Migration Network, Bird Migration Research Station, Gdansk Univ. Poland) including measurements (wing length, tail length, wing formula, fat score, and bird weight).

Personnel: four persons are usually working in the ringing station, two from Poland and two Egyptians of WRPA staff (Table 4).

Equipment: Nets, Field guides, rulers, balance, experiments cages, campus, rings and one car.

Methods: Bird ringing depends on the caught birds especially passerines using special nets (mist net) with certain mesh size according to the group of bird will caught by it. After that all the need measurements can easily taken (species identification, sex/age detection and direction of migration by orientation experiment) and putting a ring in the bird leg.

Frequencies: this work was carried out during the migration seasons (spring, 2/3 – 28/4/ 2001 and autumn, 2/9 – 28/10/2001) the wok is starting (from 6:30 to 11: 00 o'clock) in the morning and (from 17.00 to 19: 30 o' clock) in the evening.

3.2.3. RESULTS

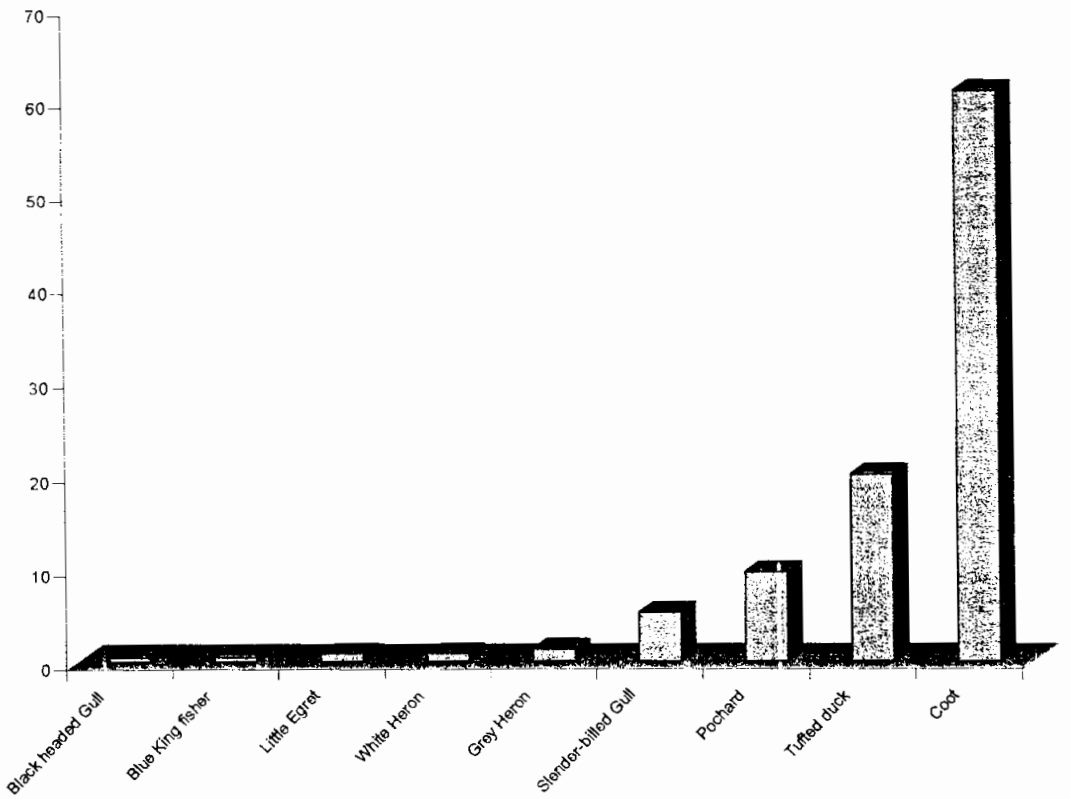
3.2.3.1. Counting

Two transects located in the Upper Lake and three in the Lower Lake, have been chosen to represent all the different type of habitat in the two lakes. The count has been repeated 2 times within 2 weeks, in order to decrease the sampling errors and to reduce the possibility of mistake, only the most common species of water-birds are recorded (Annex 6). The water bird counting has been conducted for three seasons during 2001, which are Autumn, Winter and Spring, however, due to a problem related to the motor boat we could not complete Summer season monitoring. During the summer season a few water birds stayed in Wadi El Rayan because of their migration to their original breeding habitat.

After one year of monitoring we found fluctuation in water bird diversity and number of individuals from season to season through out the year.

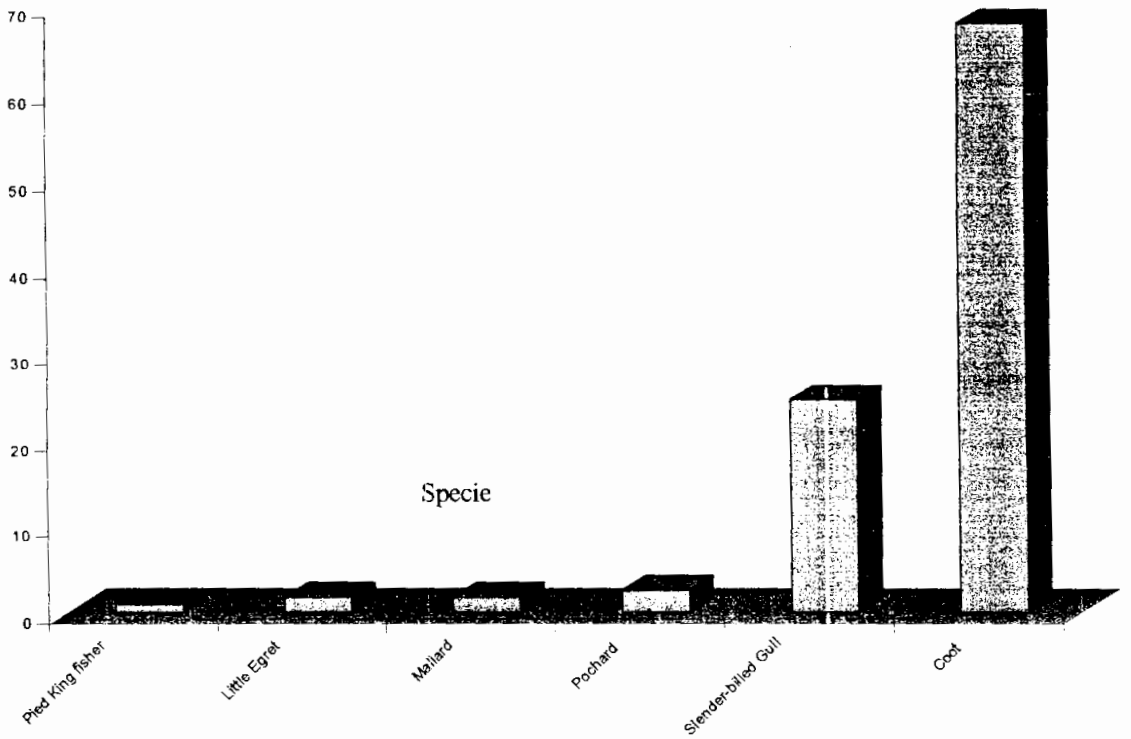
Winter Season: some of the water birds recorded in Autumn may left the place to spend the winter in another place and some of the water birds spend the winter in Wadi El Rayan. During this season counting we recorded 9 species were recorded dominated by Coot (61 %) and followed by Tufted Duck, Pochard, Slender-billed Gull, and Grey Heron, however the least abundant species was Black-headed Gull (0.44 %). (Figure 10).

Figure (10): Abundance of water bird species in Wadi El Rayan Lakes (winter 2001)



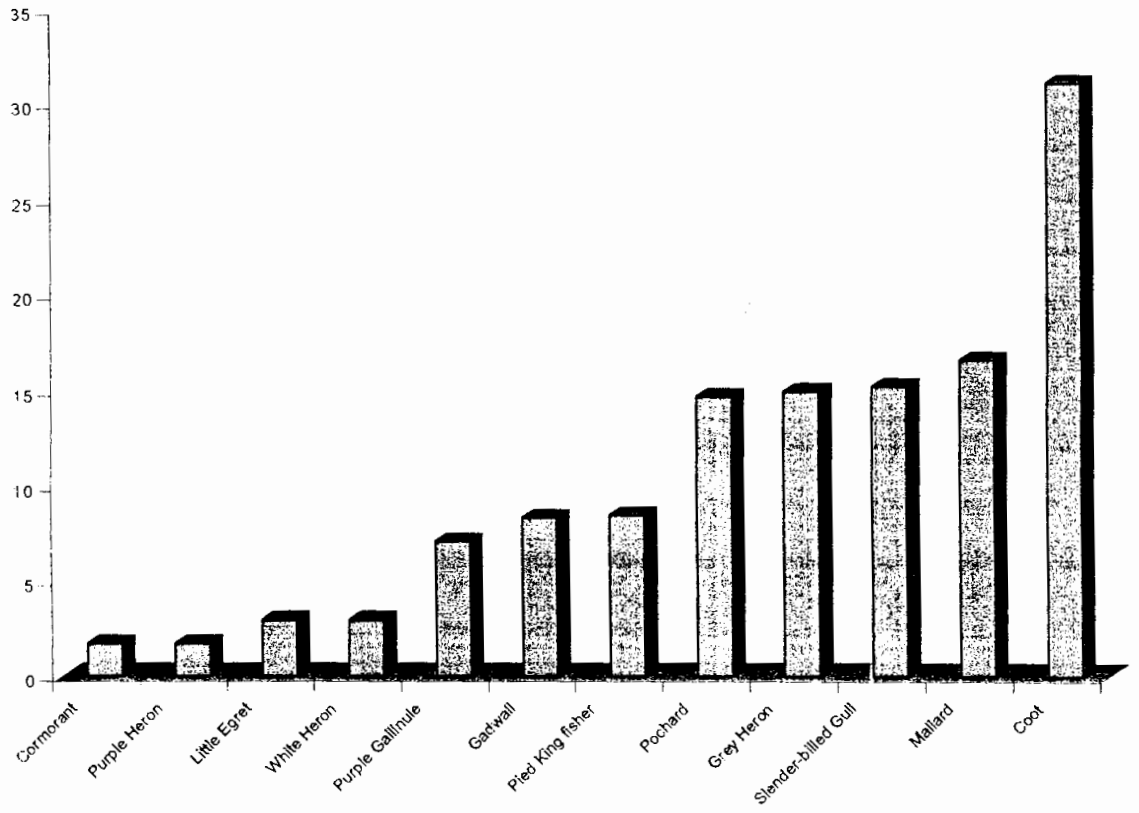
Spring Season: during this season the wintering water birds will started to migrate from Wadi El Rayan to their breeding habitats. We counted during this season 6 species dominated by Coot (68 %) followed by Slender-billed Gull, Pochard, and Mallard, while Pied King Fisher represented the least dominant species. (Figure 11).

Figure (11): Abundance of water bird species in Wadi El Rayan Lakes (spring, 2001)



Autumn Season: during this seasons the water birds started to arrive to Wadi El Rayan for stopover to take some rest and food after the long travel through the sea. During this season 12 species have been counted, the most abundant species was Coot which represents 31% of the counted species followed by Mallard, Slender-billed Gull, Grey Heron, and Pochard, while the lest abundant species was Cormorant (1.6 %). (Figure 12)

Figure (12): Abundance of water bird species in Wadi El Rayan Lakes (autumn, 2001)

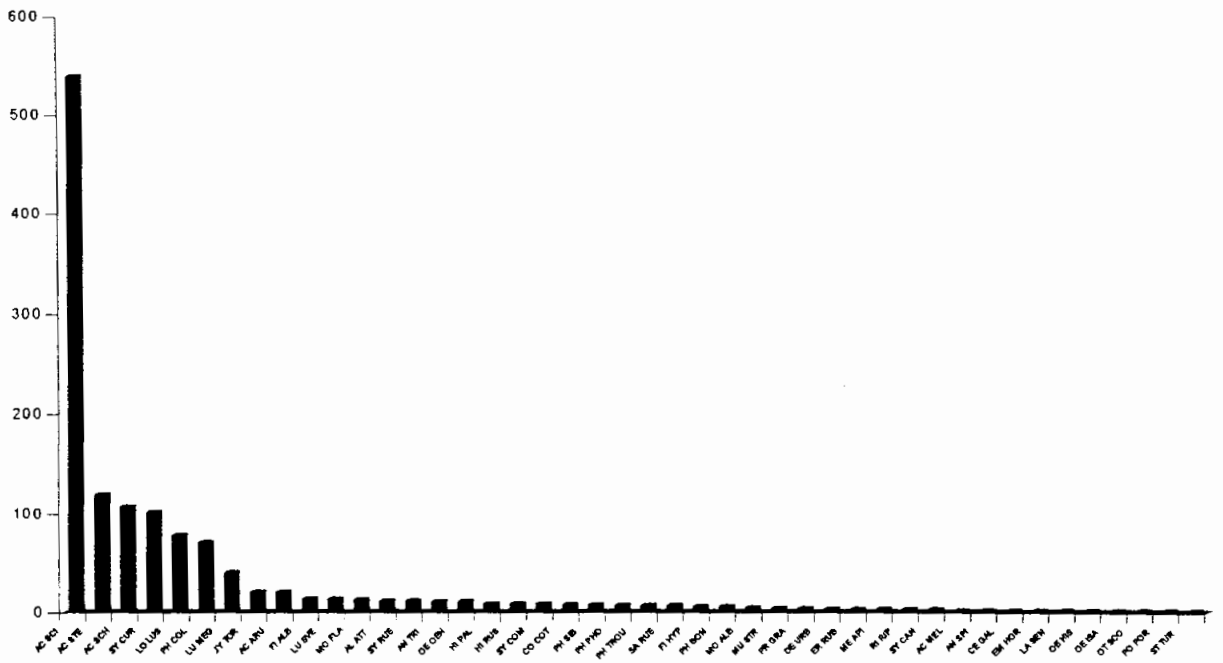


3.2.3.2. Ringing

The bird ringing station is located on the shoreline of the lower lake. The bird ringing was conducting in the migration seasons (spring and autumn / 2001), with fixed net positions and number.

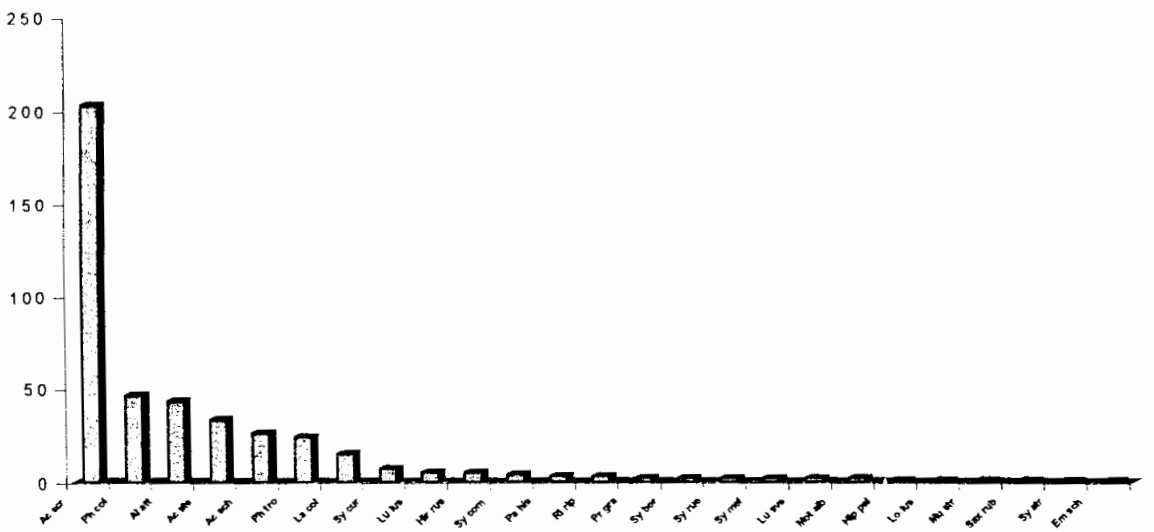
In spring season total of 1274 individuals of 44 species were caught, 12 of them were recorded for the first time in Wadi El Rayan. Between these species Reed Warbler (Ac ser) was the most common caught where 537 individuals were caught during this season. (Figure 13)

Figure (13): Number of bird species Ringed in Wadi El Rayan in Spring, 2001.



In autumn, a total number of 435 individuals from 25 different species were caught, from which 5 species were recorded for the first time. The most common species was Reed warbler (203 individuals were caught). (Figure 14).

Figure (14): Number of bird species Ringed in Wadi El Rayan in autumn, 2001.



3.2.4. PROPOSAL FOR NEXT YEAR MONITORING

Avoiding some problems faced us during motorboat counting for water birds, we proposed to start another system of bird counting which depend on stands counting, where 12 stations were detected on the two lakes to be fixed stations for water birds counting.

Required equipment: One Car, Good Telescope, Two Good Binoculars, and one photographic Camera with zooming possibilities.

3.2.5. CONCLUSION

The establishment of Wadi El Rayan lakes creates an important microhabitat that is important for resident and migrant birds as well. This new habitat attracted a lot of bird species from different bird groups from passerines, waders, water birds, herons and birds of prey. During the first year of monitoring program (2000). A total number of 143 species have been recorded in Wadi El Rayan, however during the second year of monitoring the total number of bird species becomes 163 birds species from desert birds, reeds birds, waders, water birds, in addition to birds of pery. (Annex 6)

The bird diversity criteria in Wadi El Rayan changes from season to season through out the year due to the change of climatic condition, the seasonal variation of human activities and the needs of bird species passing or visiting the area within the different seasons. In winter and spring seasons, there is a high bird diversity in the area, may be, due to the migrant bird species are in hurry to reach its breeding habitat. They are trying to take the shorter way for migration to arrive early to find a good place for breeding, so they pass Wadi El Rayan going to West Europe. This indicate the importance of Wadi El Rayan as a stopover point, and the collection of more data in different years will give more details about the species variation through out years which will also help in environmental planning of the area and wild life conservation.

3.2.6. RECOMMENDATIONS

- Completing bird-ringing studies with possibilities for financial support to have Egyptian rings instead of Polish ones.
- Establishing Egyptian bird ringing scheme with the same standards of the most expert countries in this field.
- Establishing Ringing stations in other protected areas in Egypt especially those located in bird migration routs.
- Organizing the human activities in and surround the two lakes
- Studying the water level variation of lakes and its effect on the wild life
- Studying the water quality and control fish farms waste water
- Increase the environmental awareness of the fishermen.

Table (4): Persons participated in Bird Ringing Station work in Wadi El Rayan 2001.

NAME	AUTHORITY	DAYS
Prof. Dr. Przemyslaw Busse	SE European Bird Migration Network (Chairman)	15
Dr. Jarosław Nowakowski	SE European Bird Migration Network	60
Marzena Nowakowski	SE European Bird Migration Network	30
Pawel Piwowarski	SE European Bird Migration Network	90
Wed Abdel Latif Ibrahim	Wadi El Rayan Staff EEAA	150
Mohamed Ismail Mohamed	Wadi El Rayan Staff EEAA	90
Mohamed Ali	Wadi El Rayan Staff I.P.	60

3.3. A. Mammal Monitoring FOR Wadi El-Rayan Protected Area

By

Wed Abdel Latif Ibrahim
Senior Coordinator of Biodiversity Monitoring

Haitham Nabeeh Bedir
Senior of Biodiversity Monitoring

A.1. INTRODUCTION

In Wadi El Rayan protected area, only few species are well adapted to the extreme conditions of the real desert (Fennec fox). The animal activities are generally concentrated in vegetated area (sand dunes, inter-dunes areas, lake shore, and desert areas). The Monitoring program of mammals in WRPA is concerning The Large Mammals, because they are easy to study with the available equipment, Table (5).

Table (5). Species considered for the index count.

LATIN NAME	ENGLISH NAME
Canis aureus lupaster	Golden jackal
Vulpes vulpes aegyptica	Red fox
Vulpes ruepelli ruepelli	Ruppel's fox
Fennecus zerda	Fennec fox
Herpestes ichneumon	Egyptian mongoose
Felis sylvestris libyca	African wild cat
Gazella dorcas dorcas	Dorcas gazelle

A.1.1. Objectives of the study

- Studying the large mammal frequencies in Wadi El Rayan.
- Studying the seasonal variation in large mammal distribution throughout the monitoring time.

- Monitoring the impacts of human activities on the large mammal activities and distribution.
- Collecting some data about the large mammal relations with the different habitat criteria.
- Collecting data about large mammal behaviours by direct observations or the investigation of their traces.
- Using the collected data in the environmental planning and putting conservation priorities in Wadi El Rayan Protected Area.

A.2. MATERIALS AND METHODS

There are two methods are used for studying the distribution and seasonal changes in mammal activities throughout Wadi El Rayan different habitats. These methods are Strip transect and Arial Survey.

A.2.1. Strip Transect

The methodology is the index count for presence signs along strip transects (Mooty, *et al.*, 1984; Van Dyke *et al.*, 1986). These counts will allow to compare differences concerning wildlife abundance among different habitats and to monitor seasonal distribution changes.

There are five zones were selected for monitoring to represent Wadi El Rayan habitats, Table (6) (Figure 15a).

Table (6): Zones selected for large mammals monitoring in 2001.

Zone	Location	Transect No.
First	Springs area	3
Second	Hatyet Al- Rowyan area	1
Third	Second lake	2
Fourth	First Lake	2
Fifth	Fossil area	2

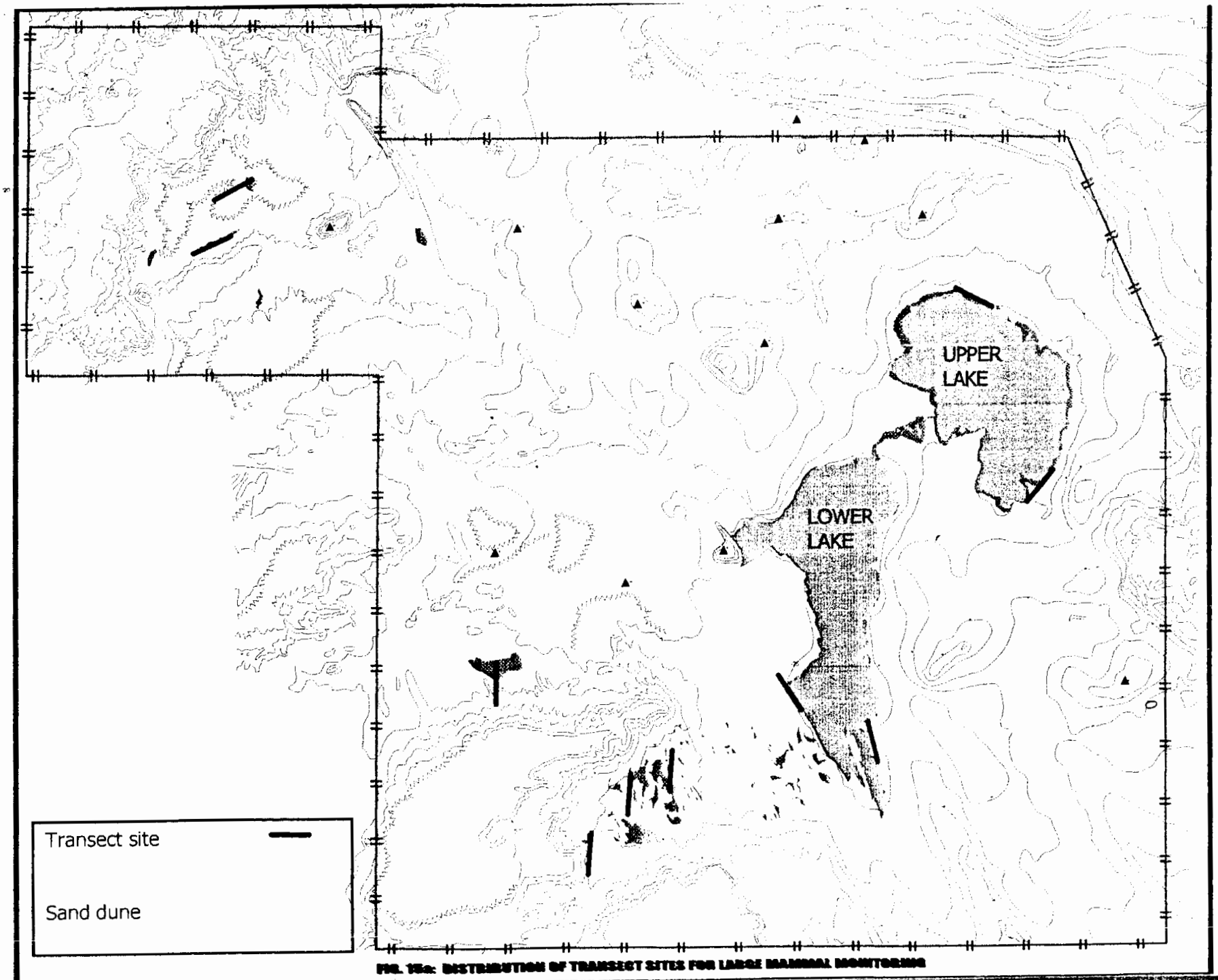


FIG. 15a: DISTRIBUTION OF TRANSECT SITES FOR LARGE MAMMAL MONITORING

Personnel: transects were surveyed by a team of 2 persons for observation and a recording.

Equipment: compass, GPS, pencils, binocular, data sheets, and one car.

Frequency: The monitoring was four times per year (Seasonal monitoring). The time of monitoring was fixed during seasons. Each transect is walked every 3 months within a defined two-week period.

Method: Transects have been located in a non-random way, because of the non-random distribution of the habitats and, consequently, of the mammals in WRPA (stratified sampling). Each transect is 2 Km length and 10 meters wide and it is walked at constant speed of about 3 Km/hour. The observers record the species and the kind of sign (track or feces) that they found inside the transect strip.

A.2.2. Arial Survey

This survey was done two times per month, using the car. The workday was divided into 2 monitoring times, which are the day monitoring (6 A.M. to 3 P.M.) and night one (8 P.M. to 12 P.M.).

A.3. RESULTS

During the year of monitoring, WRPA staff realized the strip transects for counting of indirect index of presence (tracks and feces) in ten fixed transect, which are covering four different habitats. These habitats are 1) vegetation in the desert, 2) shore of the first lake, 3) shore of the second lake and 4) spring area. The starting and ending points of each transect have been marked, and the walking direction has been noted.

A.3.1. INDIRECT OBSERVATION:

Verification of the presence of the African wild cat and Mongoose (along the shores of the lakes), the fennec and rupppell's fox (in the vegetative areas of desert), dorcas gazelle and Golden jackals (spring's area) were recorded, (IUCN, 2001a). The data collected during the year of monitoring have been analyzed and

the results of this analysis show that there is avariation in species distribution within the seasons and from zone to the other.

A.3.1.1. Large Mammals Distribution during 2001

A.3.1.1.1. Spring Season

Fox (*Vulpes sp.*): Including two species which are Red fox (*Vulpes vulpes aegyptica*) and Ruppell's fox (*Vulpes ruppelli ruppelli*). The Fox was densely present around the first lake (78 %). However, its presence around the second lake was lesser than the first lake, and the presence of the Fox was very low in the Spring Area. No records were done for the fox, during the monitoring time, in the fossil and Al-Rowayan areas.

Fennec fox (*Fennecus zerda*): The Fennec fox is densely present in the fossil area (56 %). The presence of the Fennec fox in the spring area was lesser than in the fossil area, with the least presence around the second lake. No records were done for the Fennec fox, during the monitoring time, around the first lake and in Al-Rowayan area.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was densely present only in the spring area, however it was not recorded in the other zones.

Wild Cat (*Felis libyca*), we are not sure that this species is the Wild Cat or the feral cat, which introduced from the surrounding settlement, because the direct observation of it was impossible. The presence was only recorded around the first lake, while during the monitoring time, no records were done for the wild cat in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): The presence was only recorded around the first lake, but during the monitoring time, no records were done for the Egyptian Mongoose in the other zones.

The distribution of large mammals of WRPA during the spring had been shown in figure (16).

A.3.1.1.2. Summer season

Fox (*Vulpes sp.*), The Fox was densely present around the first lake (64 %). However, its presence around the second lake was lesser than the first lake. The presence of the Fox was very low in the Spring Area. We did not record their presence in the fossil area and Al-Rowayan area.

Fennec fox (*Fennecus zerda*), The Fennec fox was densely present in the springs area (43 %), compared to the other zones. The presence of the Fennec fox in the fossil area was lesser than in the springs area, while the presence of the Fennec fox in Al-Rowayan area was the least. No records were done for the Fennec fox, during the monitoring time, around the lakes.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was commonly present in the Springs Area (57 %). The presence of the Golden Jackal in Al-Rowayan area was similar to that around the second lake. The presence of the Golden Jackal around the first lake was lesser than in Al-Rowayan. No records were done for the Jackal in the fossil area.

Wild Cat (*Felis libyca*): The distribution was only recorded around the first lake, while no records were done in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was commonly present around the first lake (86 %). The presence of the Mongoose around the second lake was lesser than that around the first lake. No records were done for the Mongoose, during the monitoring time, in the other zones.

The distribution of large mammals of WRPA during the summer season had been shown in figure (17).

A.3.1.1.3. Autumn Season

Fox (*Vulpes sp.*). The Fox was densely present around the first lake (57 %). However, its presence around the second lake was lesser than the first lake. The

presence of the Fox was very low in the spring area, while no records were done, during the monitoring time, in the fossil and Al-Rowayan areas.

Fennec fox (*Fennecus zerda*), The Fennec fox was densely present in the spring area (58 %). The presence of the Fennec fox in Al-Rowayan was lesser than that in the spring area. The presence of the Fennec fox in the fossil area was the least, and there was no record of its presence around the Lakes.

Golden Jackal (*Canis aureus lupaster*): The Golden Jackal was densely present in the spring area (53 %). The presence of the Golden Jackal around the second lake is lesser than in the spring area, while in Al-Rowayan was lesser than around the second lake, with the least presence around the first lake. No records were done, during the monitoring time, in the Fossils area.

Wild Cat (*Felis libyca*): The wild cat was only present around the lakes (first & second). The presence around the first lake was more than the second lake (10:1). No records were done about its presence in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was densely present around the Lakes .The presence around the second lake was lesser than the first lake (29 % and 71 % respectively). No records were done about its presence in the other zones.

The distribution of large mammals of WRPA during the autumn season had been shown in figure (18).

A.3.1.1.4. Winter Season

Fox (*Vulpes sp.*), The Fox was densely present around the first lake (65.5 %). However, its presence around the second lake was lesser than the first lake. The presence of the Fox was very low in the spring area, while no records were done for the fox in the fossil and Al-Rowayan areas.

Fennec Fox (*Fennecus zerda*), The Fennec fox was densely present in the spring Area (54.3 %). The presence of the Fennec fox in Al-Rowayan was lesser than in

the spring area. The presence of the Fennec fox in the fossil area was lesser than in Al-Rowayan area and the presence of it around the second lake was the least but there was no record of its presence around the first lake.

Golden Jackal (*Canis aureus lupaster*): The presence of the Golden Jackal was the highest in the spring area and around the second lake (around 30%), however the presence of the Golden Jackal around the First lake was lesser than in the spring area and the second lake, with the least presence Al-Rowayan area. We did not record its presence in the Fossils area.

Wild Cat (*Felis libyca*). The wild cat was only present around the lakes (first & second). The presence around the first lake was more than the second lake (94%), but no records about its presence in the other zones.

Egyptian Mongoose (*Herpestes ichneumon*): It was densely present around the Lakes .The presence around the second lake was lesser than first lake (20 % and 80 % respectively), and no records about the presence of the animal were found in the other zones.

The distribution of large mammals of WRPA during the autumn season had been shown in figure (19).

During The year of monitoring, the Gazelles were present only in the spring area. Where, it lives in the spring area and some time it was visiting Al-Rowyan (during the summer season).

A.3.1.2. Seasonal Mammals Activities

During the monitoring time, seasonal variation was realized in the mammal activities, which may be related to the variation in climatic conditions, animal behaviour and the relationships among these mammals themselves and the other animals as well.

The number of tracks have counted during the monitoring program were founding depending on the mammal activities, (Don E. Wilson *et al.*, 1996). The

Relative percentage of tracks counted during monitoring time has been shown in Table (7).

Table (7): Relative percentage of large mammals' tracks in Wadi El Rayan, 2001.

SEASON / SPECIES	SPRING	SUMMER	AUTUMN	WINTER
Fennec Fox	7.01	21.40	33.21	38.38
Fox sp.	10.66	21.94	37.62	29.78
Golden Jackal	2.56	17.95	42.31	37.18
Wild Cat	6.82	27.27	25.00	40.91
Mongoose	7.69	26.92	26.92	38.46
Dorcas Gazelle	17.14	54.29	17.14	11.43

The highest activities for Fennec fox was recorded during the winter season, where winter is the breeding season for this species (January to February), (Chris and Tilde S., 1997), however the less activities was recorded in spring season, due to the climatic conditions and food availability, so the Fennec is under low stress, and it does not need spend efforts for food searching. The activities of the Fox show that, it was the highest during the autumn and winter because they representing the breeding periods for this species (December to January), (Chris and Tilde S., 1997), while the less activities was recorded in the spring season. The Golden Jackal was highly active during autumn and winter seasons (Estes, 1992), while the activities of this species was the least during the spring season. The highest activities of both Wild Cat and Egyptian Mongoos were recorded in the winter season, however it was less active during the spring season. Dorcas Gazelle activities were the highest in the summer season, due to the shortage of water in their resting place among the mountains, so they inter to the spring area for the spring water, while the least activities were recorded in winter season.

It was concluded that the least activities for the large mammals in Wadi El Rayan was in the spring season, however, all the activities of mammal species (except Dorcas Gazelle) were mainly concentrated in autumn and winter seasons.

A.3.2. DIRECT OBSERVATIONS

In the spring season, Red fox and Egyptian mongoose (on the shoreline of the first lake) were observed. While in the summer season Fennec fox (In Al-Rowayan area) and Dorcas gazelle (in the spring area) were observed. In autumn Fennec fox (in the spring area) and Red Fox (on the shorelines of the first lake) were observed, see table (8).

Table (8): Wild large mammal species observed in WRPA by the protected area staff. (2001)

SPECIES	ENGLISH NAME	DIRECT OBSERVATION	INDIRECT OBSERVATION
Canis aureus lupaster	Golden jackal	♦	♦
Fennecus zerda	Fennec	♦ Su ,Au	♦
Vulpes vulpes Aegyptica	Red fox	♦ Sp ,Au	♦
Vulpes ruepelli Ruepelli	Ruppell's sand fox		♦
Felis sylvestris libyca	African wild cat		♦
Gazella dorcas Dorcas	Dorcas gazelle	♦ Su	♦
Herpestes ichneumon	Egyptian mongoose	♦ Sp	♦

Sp: spring seasone Su: summer Au: autumn

3.3. B GAZELLE SURVEY MAY 2000 TO DECEMBER 2001

B.1. MATERIALS AND METHODS

The survey was done by non-randomly selected position which depended on knowing the distribution of gazelles in WRPA, so we selected two places , the first one in Al-Rowayan area and the other in the spring area. It is necessary to investigate all the vegetation in the selected areas and record the GPS points and number of individuals observed and Gazelle tracks and feces that have been found. During this period there was no timetable for survey.

B.2. RESULTS

B.2.1. Direct observation

Direct evidences of the Dorcas gazelle (*Gazella dorcas*) presence have been recorded in WRPA. There was no direct observation for the Slender Horned Gazelle (*Gazella Leptocerus Leptocerus*) (IUCN, 2001a). After the present survey there was no direct observation of Slender Horn gazelle and also no one recorded it since long time (more than 15 years) in WRPA. (Saleh, 1987). The population of the Slender Horn gazelle could be migrated from WRPA where, this species of Gazelle is strongly nomadic (Estes, 1992).

During more than one year (May 2000 until December 2001), the data included only six direct observations for Dorcas Gazelle. The direct observations included five times in the spring area (two times a group of three adults, two times a group of two adults and the fifth time was one adult) and the sixth time was in Al-Rowayan (one adult). The observations have been shown in table (9). (Figure 15b)

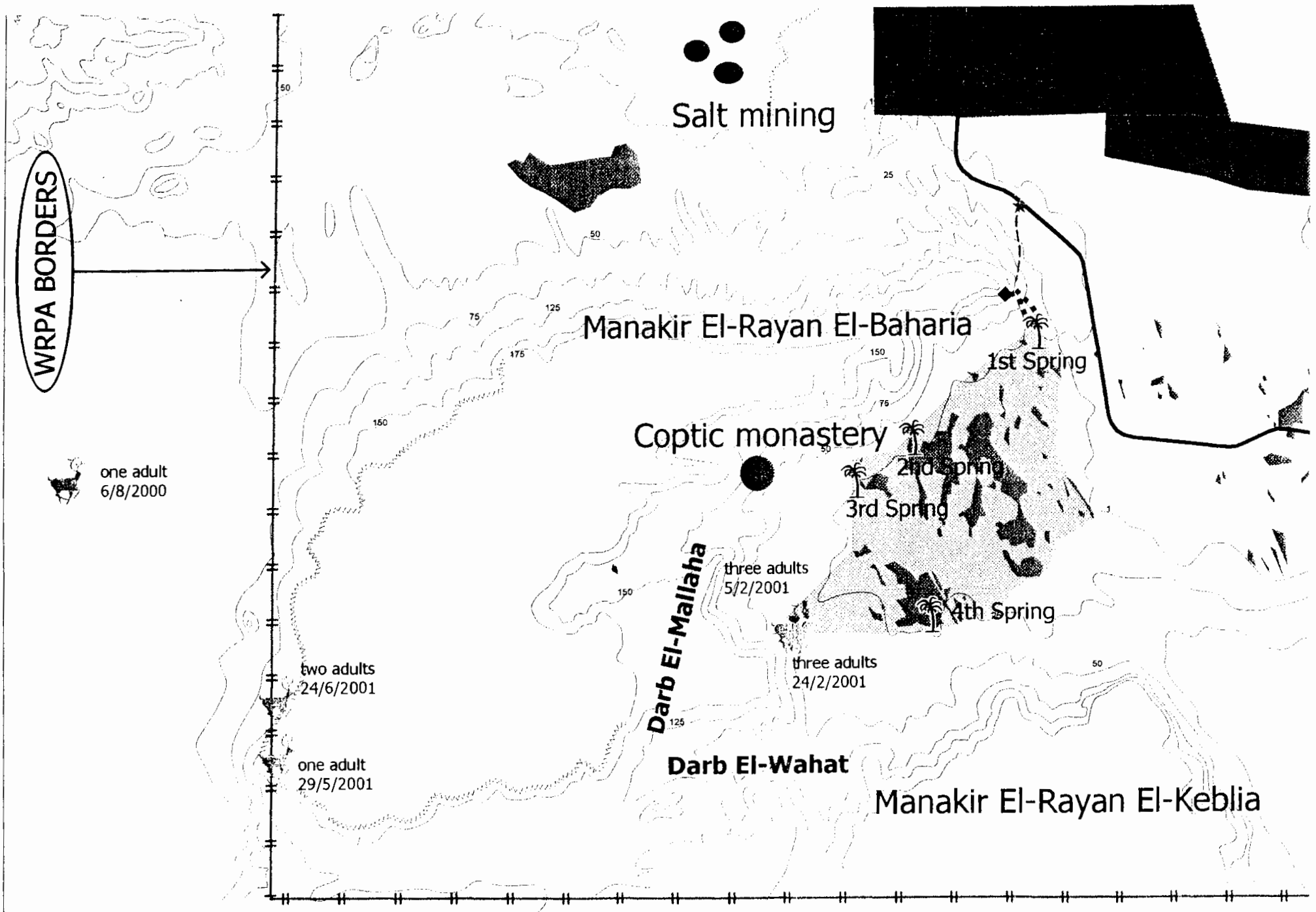


FIG. 15b THE DIRECT OBSERVATION POINTS OF THE DORCAS GAZELLE

Table (9): The direct observation of the Dorcas gazelle inside WRPA from May 2000 until May 2001

NO.	PLACE	DATE	TIME	GPS POINT	ESCAPING DIRECTION	OBSERVATION
1	AL-ROYANE	6/8/2000	7:30 A.M.	N: 29 0726 0 E : 30 1340 2	165 S-E	Only one adult dorcas gazelle
2	SPRINGS AREA	5/2/2001	12:45 P.M.	N: 29 04727 E: 30 27590	250 S-W	Three adults dorcas gazelle
3	SPRINGS AREA	24/2/2001	10:40 A.M.	N: 29 04657 E: 30 27750	260 S-W	Three adults dorcas gazelle
4	SPRINGS AREA	29/5/2001	9:30 A.M.	N: 29 02471 E: 30 17578	150 S-E	Only one adult dorcas gazelle
5	SPRINGS AREA	24/6/2001	11.00 A.M.	N: 29 03471 E: 30 17578	170 S-E	Two adults
6	SPRINGS AREA	30/6/2001	10.10 A.M.	NOT RECORDED	180 S-E	Two adults

B.2.2. Indirect observation

Many indirect evidences about the presence of gazelle individuals have been found in the selected study area and data collected are shown in table (10).

Table (10): The indirect observation of the Dorcas gazelle in WRPA from December 2000 until May 2001

NO.	PLACE	DATE	GPS POINT	OBSERVATION
1	AL-ROWYANE	26/5/2000	N: 29 12650 E: 30 23302	Tracks and feces
2	AL-ROWYANE	3/6/2000	N: 29 12545 E: 30 23280	Tracks and feces
3	AL-ROWYANE	1/7/2000	N: 29 1085 E: 30 2333	Tracks and feces
4	SPRINGS AREA	17/8/2000	N: 29 0302 .9 E: 30 1443 .0	Tracks and feces
5	SPRINGS AREA	3/9/2000	N: 29 3 .7 E: 30 1453 .7	Tracks and feces
6	SPRINGS AREA	1/10/2000	N: 29 259 .5 E: 30 1455 .1	Tracks and feces
7	SPRINGS AREA	15/12/200	N: 29 3 .7 E: 30 15 .5	Tracks and feces
8	SPRINGS AREA	12/2/2001	N: 29 0302 .9 E: 30 1443 .0	Feces only
9	SPRINGS AREA	23/3/2001	N: 29 259 .5 E: 30 1455 .1	Feces only
10	SPRINGS AREA	10/4/2001	N: 29 257 .8 E: 30 1505 .1	Tracks and feces
11	SPRINGS AREA	10/4/2001	N: 29 254 .9 E: 30 1515 .6	Tracks only
12	SPRINGS AREA	30/4/2001	N: 29 04827 E: 30 27562	Tracks of three individual and feces
13	AL-ROWYANE	1/5/2001	N: 29 12743 E: 30 23853	Feces only
14	AL-ROWYANE	1/5/2001	N: 29 12581 E: 30 22299	Feces only
15	SPRINGS AREA	5/8/2001	N: 29 04955 E: 30 27645	Tracks only

16	AL-ROWYANE	7/8/2001	NOT RECORDED	Track only
17	SPRINGS AREA	3-11-2001	N: 29 04782 E: 30 27712	Tracks and feces
18	SPRINGS AREA	30/11/001	N: 29 04815 E: 30 27685	Feces only
19	SPRINGS AREA	5/12/001	N: 29 05105 E: 30 28022	Tracks and feces
20	SPRINGS AREA	11/12/001	N: 29 04709 E: 30 27820	Track of one individual only

The data shows that the total surface area that is used by the gazelle is around 17000 ha. No evidences about its presence have been found outside this territory, (IUCN, 2001a). This small population of Dorcas gazelles (from 3 to 6 individuals) lives in the spring area and sometimes visits Al-Rowayan area (especially during the summer season). This population spending the daytime feeding on the vegetation because all the direct observation times was recorded between 7:30 AM to 12:45 PM. The night time can be in the S-W mountains in the spring area.

The hunting stress in the past (ten years ago) in the spring area led to decreasing the number of gazelle population, that the strong gazelle individuals might be migrated to other place outside WRPA (Acacia forest in the western desert, 100 km far from the spring area).

While the direct and indirect observations gazelle was observed among the plant populations of *Nitraria retusa*, *Calligonum polygonoides* and *Alhagi graecorum*. One of these direct observations, the gazelle was found eating *Alhagi sp.* So there is direct relation between the presence of these plant species and the presence of the gazelle community that depending on this plant species as a food source.

Figure (16): Distribution of Large Mammals species in Wadi El Rayan during spring season 2001.

Figure (17): Distribution of Large Mammals species in Wadi El Rayan during Summer season 2001.

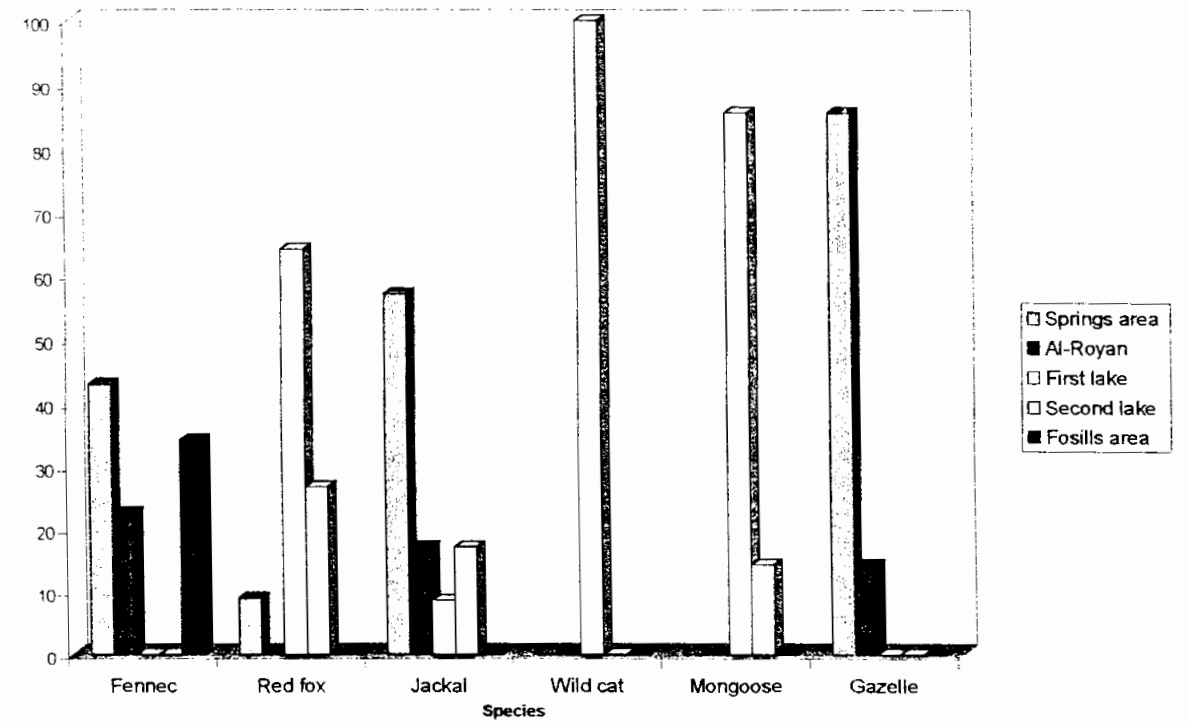


Figure (18): Distribution of Large Mammals species in Wadi El Rayan during Autumn season 2001.

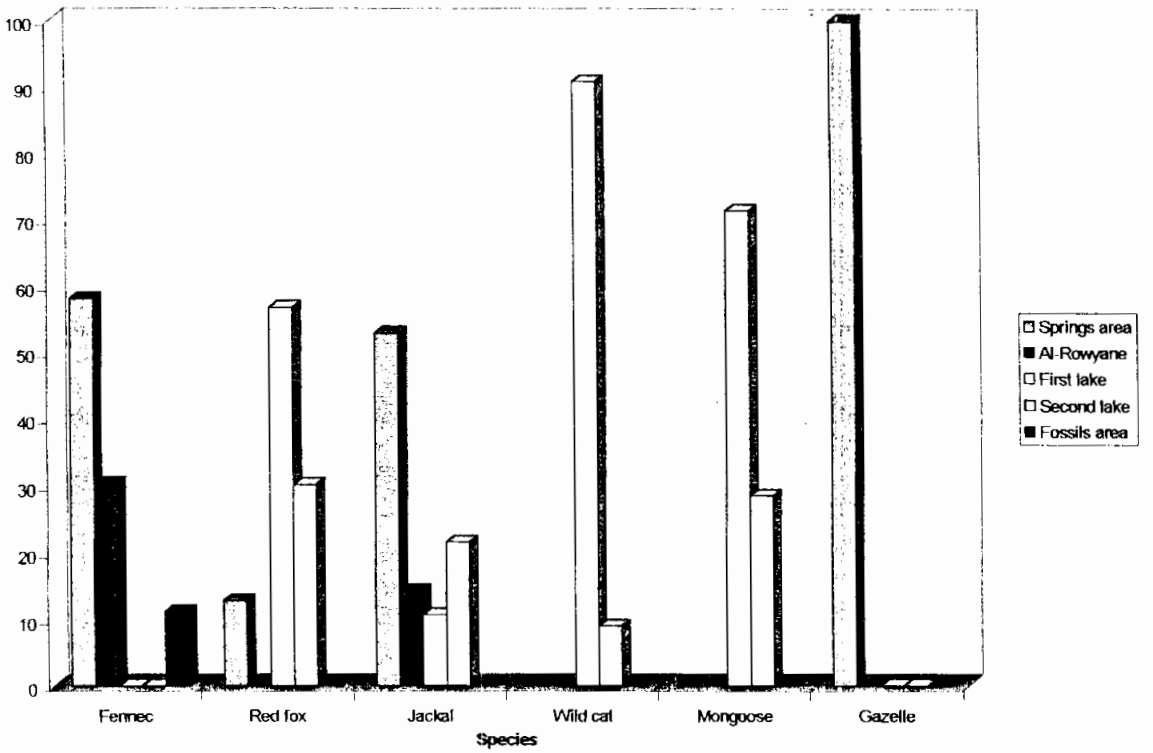
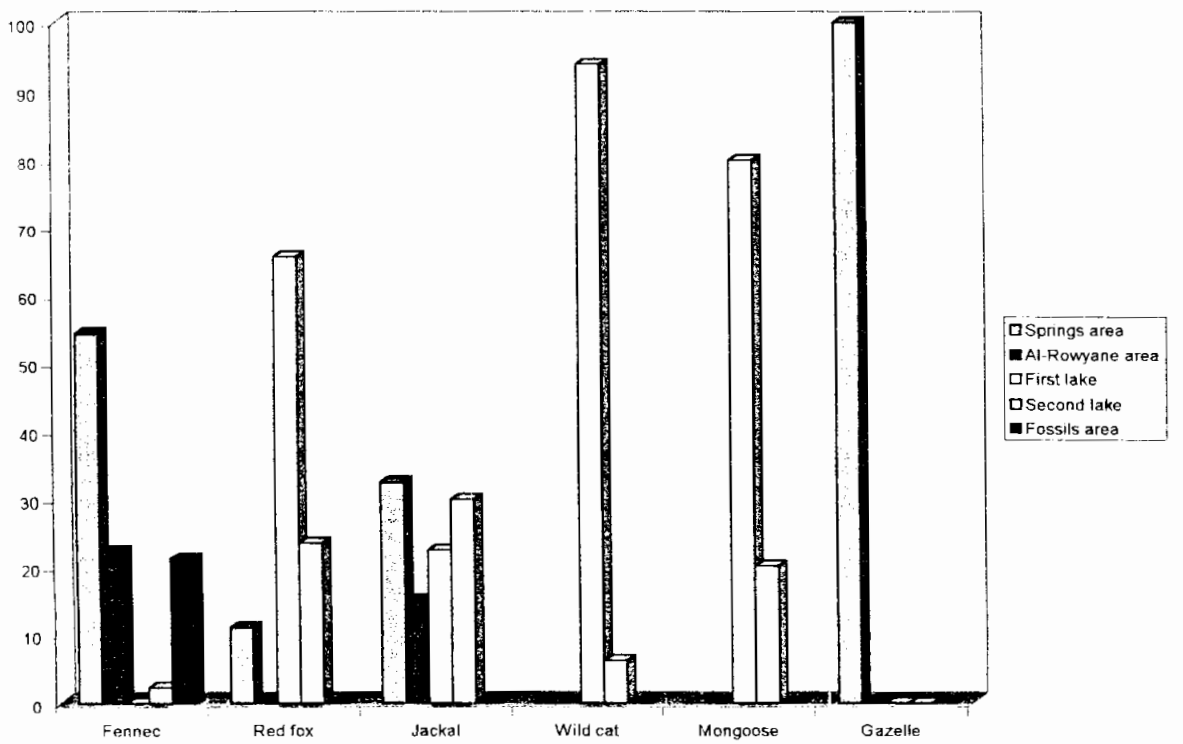


Figure (19) Distribution of Larger Mammals species in Wadi El-Rayan during Winter season 2001-2002.



B.3. CONCLUSION

- The fennec fox is the most adapted animal to the real desert environment. The fennec fox was densely present in the fossil area during the spring season, while in the other seasons it was frequent in the spring area. In general this species was highly active during the winter season (breeding period).
- The fox sp. (Red and Ruppel), during the four seasons, were densely present around the first lake, and were highly active during the autumn season.
- The Golden Jackal has high record of activities during autumn, with a frequent record inside the spring area in all the seasons of the year.
- The presence of animal had found to increase while the period of closing the two lakes for fishing, due to the fewer disturbances coming from fishing activities.
- There was no record about the Slender Horned Gazelle in WRPA.
- The number of Dorcas gazelle individuals in WRPA is not more than six individuals. The highest activities for the dorcas gazelle were recorded during the summer season due to the food and water availability inside the spring area.
- Both Wild Cat and Mongoos are common around the lakes (especially the first lake).
- The most important season for the large mammals is the winter, and the important habitat for them is the spring area.

B.4. RECOMMINDATION

- The gazelle survey must be continued in order to monitor the effects of the hunting control and their territory protection on the population size.

- It is important to use other methods for large mammal monitoring (Camera trap to know exactly the condition of the gazelle individuals and to be sure about the presence of Slender Horned Gazelles).
- The regular collection of the track sizes should be used to distinguish the different individuals in order to assess the population composition and dynamic.
- Restricting the human access to the spring area and the southern part of the second lake.

PART IV

4. RESOURCE & ENVIRONMENTAL MONITORING

4.1. GEOLOGY AND PALEONTOLOGY MONITORING

4.2. A. WATER QUALITY MONITORING

4.2. B. WATER QUALITY AND FISH FARMS IN WADI EL-RAYAN PROTECTED AREA

4.3. IMPACT MONITORING OF THE ECONOMIC ACTIVITIES

SITE INSPECTION: WASTE MONITORING:

4.4. VISITOR MONITORING

GEOLOGY AND PALEONTOLOGY MONITORING FOR WRPA

MONITORING REPORT

(DECEMBER 2001)

4. RESOURCE & ENVIRONMENTAL MONITORING

4.1. GEOLOGY AND PALEONTOLOGY MONITORING

By
Geologist **Mohamed Sameh M. Anter**
Senior of Geology and Paleontology Monitoring

4.1.1. INTRODUCTION

Fossil area (Wadi El-Hitan) is considered one of the most attractive zones in Wadi El-Rayan Protected Area. It is characterized by its magnificent Saharan scenes and considered as one of the most interesting paleontological sites not only in Egypt but probably also in the world.

The valley of Wadi El-Hitan is bout 7 sq. Km and located 12 Km W.S.W of the Garet Gohannam formation. This area is characterized by the presence of interesting vertebrate fossils which are skeletons of whales date back to about 40 million years ago, scattered in Wadi El-Hitan and embedded in a thin layer of sand and parts of them are exposed to the surface.

Geology of Wadi El-Hitan

Wadi El-Hitan is about 12 km WSW of the hill Garet Gohannam, this valley was covered by Eocene sea for about 2 million years (39-41 million years ago). Isolated hills, hillocks of peculiar shape sculptured by the weathering action of the wind and rains also earth pillars are found in many places.

Three kinds of geological formations are exposed in the fossil area: -

1. The lowest (oldest) is the Gohannam formation dating back to about 40-41 million years ago. It consists of white marly limestone and gypseous clays. This formation yields many skeletons (*Basilosaurus isis, Zeuglodon osiris*), beside plenty of the micro foraminifers (*Nummulites frassi, Nummulites beaumensis*), and macro invertebrates (*Vusella crispata, Lucina fajumoni*).

2. Birket Qarun Formation that yields also remains of the Eocene whales skeletons. This formation consists of sandstone, clays and hard calcareous limestone which almost invariably weathered giving rise to peculiar shape of rock. This formation yields the gastropod (*Drepanocheilus wagihi, Nautilus*).

3. The highest (younger) is the Qasr El Sagha Formation of late Eocene age, it yields (*Turritella carinifera, Nicaisoloph clot-beyi, Pycnodonte gigantica, Turritella pharaonica, Ostrea elegans*). This formation consists of limestone and this area shows a shallow marine environment that suggests different environment than in northern Fayoum depression where it shows fluvial marine environment.

4.1.2. MATERIALS AND METHODS

4.1.2.1. Photo monitoring

In order to protect this fossil site from the non-aware visitors and to control the fossil condition a photo- monitoring system has been established.

Each fossil sit has been mapped, photographed and numbered. The routine patrolling is realized by EEAA researchers in the fossil area twice per week (during the weekend, when normally the area is visited by the tourists), once per month the condition of each fossil site is verified through the comparison with the photo and once every three months to chick the condition of each fossil sit to repair the broken parts of the skeletons.

The main features of the photo monitoring are the following:

Personnel: - 2 personnel, 1 community guard and 1driver

Equipment: 4WD car, digital camera, GPS, data sheets, pencil, compass, the file of the fossil photos.

Frequency: once per month

4.1.2.2. Fossil sites repairing procedure

The procedure that has been used to repair the most interesting fossil sites is the following:

- Removing the sand from the fossils.

- Looking for the entire skeleton component.

-Cleaning the fossil constituents.

-Mending the broken parts of the skeleton.

-Painting the fossil component with a hardener substance (polyvinyl acetate).

-Arranging the different parts of the skeleton in the right position and detecting the missing ones.

Personnel: 1 EEAA researcher (geologist), 1 researcher trained on fossil repair methodology, 2 community guard

Equipment: 1 pale, 2 brushes, polyvinyl acetate, glue Vinavil

Frequency: every three months and when needed

4.1.3. RESULTS

4.1.3.1. Photo monitoring

35 fossils have been photographed and numbered. Every month the comparison between the photos and the sites has been made. Until now no damages have been discovered only small movements of the skeletons pieces.

4.1.3.2. Fossils sites description and repair.

A total of 25 fossils sites have been identified and described (El Bedewy, 2000). Cetaceans are the most dominant vertebrates in Wadi El-Hitan in addition to sharks (fossil shark teeth). Eocen whales were different from those of the modern groups and are placed in a separate suborder Archaeoceti. The body was

very long up to 21 meter long and apparently thinner than modern whales, the skull was long and the nostril was some way back.

The teeth are very interesting that they were of the normal mammalian number (44) and show some signs of the heterodont arrangement.

The most common mammal fossils skeletons found in the area is the *Basilosaurus isis*, mammal of 12-24 meters and more than 7 tons of weight common in Eocene oceans. Three skeletons of this species have been repaired. One fossil skeleton of *Zeuglodon osiris* has been transferred near the visitor center of WRPA. The protected area researchers have completed the restoration of site number 14 and added anew five pieces.

4.1.3.3. Description of the restored fossil sites

Three sites have been restored, and described as follows: (Beadnell, 1905; after El-Bedewy, 2000)

Site No. 8

Scientific name: *Basilosaraurus isis*

The skeleton consists of cervical, thoracic and caudal vertebrae in a good state of preservation and 14 vertebrae displayed until now and attain a length of 9 meters.

Site No. 14

Scientific name: *Basilosaraurus isis*

The skeleton consists of partial skull and cervical, thoracic and caudal vertebrae in a good state of preservation and 16 vertebrae displayed until now and attain a length of 10 meters.

Site No. 20

Scientific name: Basilosaraurus isis

The skeleton consists of cervical, thoracic and caudal vertebrae in a good state of preservation and 10 vertebrae displayed until now and attain a length of 6.5 meters.

4.1.3.4. Vertebrate fossils

Table (11): Vertebrate fossils of Wadi El-Hitan (El Bedewy, 2000)

SPECIES	CLASS	FAMILY	GENUS	NAME AFTER
Ancalecetus simonsi	Mammalia	Basilosauridae	*Dorudon osiris*	Gingrich, 1996
Basilosaurus isis	Mammalia	Basilosauridae	*Basilosaurus*	Cope, 1868
Zeuglodon osieis	Mammalia	Basilosauridae	*Dorudon osiris*	Dames, 1894

4.1.3.5. Shark teeth:

Table (12): Shark teeth (El Bedewy, 2000)

SPECIMEN	CLASS	FAMILY	GENUS	NAME AFTER
Shark teeth	Elasmobravchii	Mitsukurinidae	Scapanorhynchus	Woodard, 1889

4.1.3.6. Mangrove

Another kinds of fossils have been found in Wadi El Hitan that fossilized plant, its Mangrove (*Rhizophora, Sonneratia).*

Mangrove communities can be traced back to Early Tertiary, 55 million years ago, largely by means of palynology. There is a gradual expansion in the diversity and association of mangrove genera from Earliest Eocene time. Pollen grains from the black mangrove genera, *Nypa* and *Browlowia* occur together in the Lower Eocene of Borneo. Mangroves appear in successive epochs include *Rhizophora* pollens in the Early Oligocene, *Sonneratia* pollens in the Early Miocene. Pollen assigned to *Rhizophora, Sonneratia* and *Nypa* had been described from the Middle Eocene.

4.1.3.7. Invertebrate fossils

The macroinvertebrate faunas are commonly found in three major rocks; shales, compact white limestone and sandy hard brown limestone.

The preservation mode of fossils is widely varied in these types of rocks. In most cases the specimen occurs as mold obscuring their internal structure, in most cases their external features. The following table summarizes the invertebrate species of fossils that have been identified.

Table (13): Invertebrate fossils of Wadi El-Hitan (El Bedewy, 2000)

SPECIES	CLASS	FAMILY	GENUS	NAME AFTER
Cardita viquesneli	Bivalvia	Carditidae	Cardita	Oppenheim, 1903
Carolia plcunoides	Bivalvia	Anomiidae	Carolia	Cantraine,1838
Drepanocheilus wagihi	Gastropoda	Aprrhaidae	Drepanocheilus	Abass, 1963
Lucina fajumensis	Bivalvia	Lucinidae	Lucina	Oppenheim, 1903
Mesalia fasciata	Gastropoda	Turritellidae	Mesalia	Lamarck, 1830
Nautilus mokattamesis	Cephaloposda	Nautiloidea	Nautilus	Food, 1787
Nicaisoloph clot-beyi	Bivalvia	Ostreidae	Nicaisoloph	Bellardi, 1854
Ostrea elegans	Bivalvia	Ostreidae	Ostrea	Linne, 1758
Pycnodonte gigantica	Bivalvia	Gryphaeidae	Pycnodonte	Solnder, 1766
Turritella carinifera	Gastropoda	Turritellidae	Turritella	Cossmann, 1901
Turritella pharaonica	Gastropoda	Turritellidae	Turritella	Deshayes, 1824
Vulsella crispata	Bivalvia	Carditidae	Vulsella	Fisher, 1870

4.1.4. RECOMMENDATIONS

In order to improve the monitoring program the following actions should be taken:

- Studying fossil content (vertebrate, macroinvertebrate, and microfossil).
- Studying the paleoenvironment of the area in details.
- Establishing an out post in a strategic location.
- Establishing an open-air museum.
- Geomorphological and drainage maps with suitable scale.

WATER QUALITY MONITORING & FISH FARMS IN WRPA

MONITOPRING REPORT

WINTER 2001

KEY OF ABBREVIATIONS

BOD_5	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
OECD	Organisation de Cooperation et de Developpment Economiques, France
TSS	Total Suspended Solids
TDS	Total dissolved Salts
TP	Total Phosphorus
TN	Total Nitrogen
WRPA	Wadi El-Rayan Protected Area

4.2. A. WATER QUALITY MONITORING FOR WADI EL-RAYAN PROTECTED AREA

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Senior Coordinator of Management and Effectiveness Monitoring

A.1. INTRODUCTION

Wadi El-Rayan is a depression located southwest Cairo, western desert, Egypt. In 1973, this depression has started to receive by a tunnel the excess agricultural drainage water from Fayoum Governorate. This depression acts as a reservoir of the drainage water. As there is a difference in the elevation through this depression, the received water from the tunnel creates a good system of running water in the upper Rayan Lake until reaching the big reservoir (lower Rayan Lake). A good vegetation cover along the shores of the lakes has been created in a naturally balanced ecosystem allowing to:

1. Purification of the water in the lakes to a satisfactory level, to be added to the self purification capacity of the running water, and
2. Creation of one of the most important wetland ecosystems in Egypt, with national and international importance for resident and migratory birds (144 bird species).

The program of water quality monitoring enables WRPA staff to stand on the quality of the water in the two Rayan lakes and their junction canal. The parameters analyzed and the frequency of the sample collection follow the guidelines given by the IUCN water quality experts mission (IUCN, 1999b)

The closed lower Rayan Lake receives the entire pollution load coming from different sources:

1. The upper Rayan Lake and the junction canal, (2300 feddans of authorized fish farms, from which 1000 feddans are actually acting and producing),

2. The inorganic load coming from the fertilization residues of agriculture activities, and

3. The pollution load of the lower lake itself, which comes from the fish cages and traditional fishing activities.

A.2. CLIMATE

The climate is typically Saharan, hot and dry with scanty winter rain and bright sunshine throughout the year. The area is hyper-arid with mild winters and hot summers (Zahran, 1989). The annual average of the precipitation rate is 10.1 mm. The highest rainfall occurs in December (40 % of annual rain) and the lowest (0%) in August. The average ambient relative humidity is 51%. The direction of the wind is, for most of the year, from the North, varying North-West or North-East. After Saleh *et al*, (1988). (see the next table)

Table: Summary of the monthly means of 50 years of temperature records (Saleh, 1988)

TEMPERATURE VALUES	WINTER	SUMMER
Mean	13.7°C	28.5°C
Absolute minimum/maximum	-1.2°C	48.8°C
Mean amplitude of diurnal fluctuations	14.2°C	17°C

A.3. MATERIALS AND METHODS

Materials

- Motor boat
- 4WD car
- Plastic bottles
- Ice box
- Field sheet
- Marker pen
- EEAA central laboratory for sample analyses

Methods

Each of the 2 lakes and the junction canal has 1 permanent station from which the samples were collected. Those permanent stations are one in the 1st lake (near the tunnel), one in the 2nd lake (near the fish cages) and one in the junction canal (after the output of the fish farm). One station was added to record the quality of the original wastewater income to Rayan lakes. This new station was fixed at the 1st point receiving the water (end of the tunnel, which representing the start point of the upper lake). The 4 stations could be increased for each lake and the canal, and the mean values of the results recorded. WRPA staff collected subsurface grab water samples, once for each season from these 4 stations (December, March, June, and September). Collected water samples immediately transferred to the EEAA laboratory in Cairo to be analyzed. (See table 14)

Table (14): The tested water quality parameters

PARAMETER	SYMBOL	UNIT OF MEASURE
Hydrogen ion conc.	pH	Units
Biological oxygen demand	BOD_5	Mg/L
Chemical oxygen demand	COD	Mg/L
Total suspended solids	TSS	Mg/L
Total dissolved salts	TDS	Mg/L
Ammonia	NH_4^+	Mg/L
Nitrites	NO_2	Mg/L
Nitrates	NO_3^-	Mg/L
Phosphates	PO_4^-	Mg/L
Total nitrogen	TN	Mg/L
Total phosphorus	TP	Mg/L
Lead	Pb	Mg/L
Mercury	Hg	Mg/L
Cadmium	Cd	Mg/L
Manganese	Mn	Mg/L
Arsenic	Zn	Mg/L
Ferrous	Fe	Mg/L
Cupper	Cu	Mg/L
Mercury	Hg	Mg/L
Magnesium	Mg	Mg/L

A.4. RESULTS

3 groups of results were obtained for the 2 Rayan lakes and their junction canal as shown in the table (15) that showed the physico-chemical parameters. These groups were completely analyzed in the central Laboratory of the Egyptian Environmental Affairs Agency (EEAA). Metals were twice analyzed at 9/9/2000 and 11/12/2001 as shown in table (16).

Table (15): Physico-chemical parameters of water samples for Rayan lakes

Date	Stations	pH	TDS	TSS	BOD	COD	TP	TN	NH_4	NO_3	NO_2	Po_4
13/10/99	Upper Lake	6.4	1218	-	15	30	-	-	-	-	-	-
	Junction Canal	7.8	1420	-	30	46	-	-	-	-	-	-
	Lower Lake	8.5	4936	-	31	55	-	-	-	-	-	-
9/9/00	Upper Lake	-	1509	11.3	-	-	0.34	1.2	-	-	-	-
	Junction Canal	-	1552	11.3	-	-	0.26	1.24	-	-	-	-
	Lower Lake	-	5632	8.7	-	-	0.28	1.3	-	-	-	-
11/12/01	Tunnel	8.0	769	114	1.2	5.3	1.72	1.454	0.044	1.05	N.D.	0.14
	Upper Lake	8.5	1618	3	5.2	15.8	0.11	1.817	0.007	**1.31**	N.D.	0.03
	Junction Canal	8.0	1597	6	4.5	14.1	**0.37**	**2.91**	N.D.	**1.51**	N.D.	0.05
	Lower Lake	8.0	**6264**	39	6.5	21.1	**0.61**	**1.38**	N.D.	1.1	N.D.	0.06

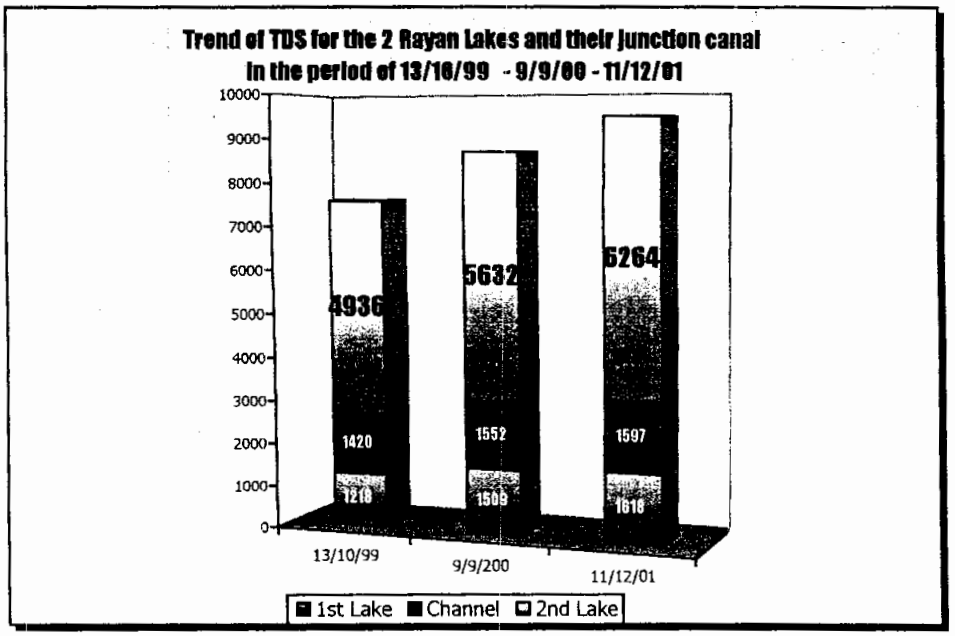
Table (16): Metal analyses of water samples for Rayan lakes

Date	Stations	Mn	Cr	Cu	Fe	Cd	Pb	Zn	Hg	Mg
9/9/00	Upper Lake	0.0022	N.D.	N.D.	0.04	N.D.	0.01	0.017	-	-
	Junction Canal	N.D.	N.D.	N.D.	0.206	N.D.	N.D.	0.019	-	-
	Lower Lake	N.D.	N.D.	N.D.	0.07	N.D.	N.D.	0.02	-	-
11/12/01	Tunnel	-	-	0.008	2.268	0.002	N.D.	0.034	N.D.	36.4
	Upper Lake	-	-	0.004	0.214	N.D.	N.D.	0.016	N.D.	341.6
	Junction Canal	-	-	0.003	0.255	0.002	N.D.	0.021	N.D.	286.0
	Lower Lake	-	-	0.005	0.257	0.002	N.D.	0.020	N.D.	270.0

The water quality of the 1st lake depends mainly on the quality of the received agricultural wastewater from the origin of the main drain. The water quality in this case will depend mainly on the composition of cultivated agricultural crops and their fertilization behavior. Winter crops differ mainly from the summer ones. Figure (1) shows the trend of Rayan Upper and Lower lakes with their junction canal towards the TDS concentrations (Total Dissolved Salts) along the period

from 9/9/2000 to 11/12/2001. The junction canal is doing the main role of the natural purification of the water of the upper Lake. The lower lake doesn't follow a clear trend for the different parameters except the TDS (salinity), see figure (20). The reason is that the lower lake acts as a reservoir receiving the entire chemical constitutes of the water. So the trend will be clearer on the long term.

Figure (20): The trend of TDS for the two Rayan Lakes and their junction canal (13/10/99 to 112/12/01)



- **TDS**

The most noticeable effect is the increase of the TDS, which represents the summation of all dissolved elements in the water. The increase is clearer in the lower Rayan Lake, which is of closed nature. The increase of TDS (as a representative of the salinity level) reached 10.1% from the period of 9/9/2000 (5632 mg/l) to 11/12/2001 (6264 mg/l).

- **TSS, BOD_5 & COD**

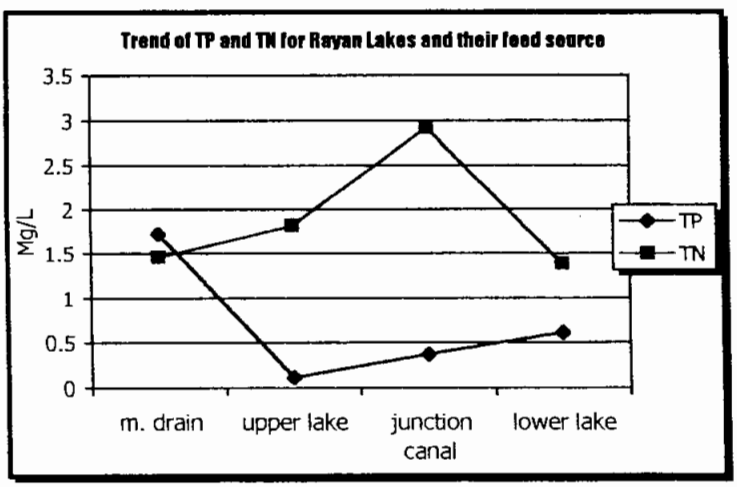
The values of these parameters usually show fluctuations according to the nature of the received water from the original drain. For the most recent sampling time, the wind velocity was high enough to make disturbance for these values.

- **TP & TN**

These values of total phosphorus and total nitrogen show important and significant trends. It was found that:

- **For the total phosphorus**, the water income carries 1.72 mg/l from the main drain, which then distributed over the entire area of the upper lake to reach 0.11 mg/l. The value showed an increase at the junction canal, after the discharge of the intensive fish farm to reach 0.37 mg/l. The lower lake showed another increase because of its closed receiving nature (0.61 mg/l), figure (2).
- **For the total nitrogen**, (sum. of nitrate-nitrogen, nitrite-nitrogen, ammonia-nitrogen and organic nitrogen), the water income caries 1.454 mg/l from the main drain. That load of nitrogen had been distributed over the entire area of the upper lake to reach 1.817 mg/l (windy day that increases the turbulence of the lake). The value showed a significant increase at the junction canal, after the discharge of the intensive fish farm to reach 2.91 mg/l. The lower lake showed another increase reached (1.38 mg/l), see figure (21).

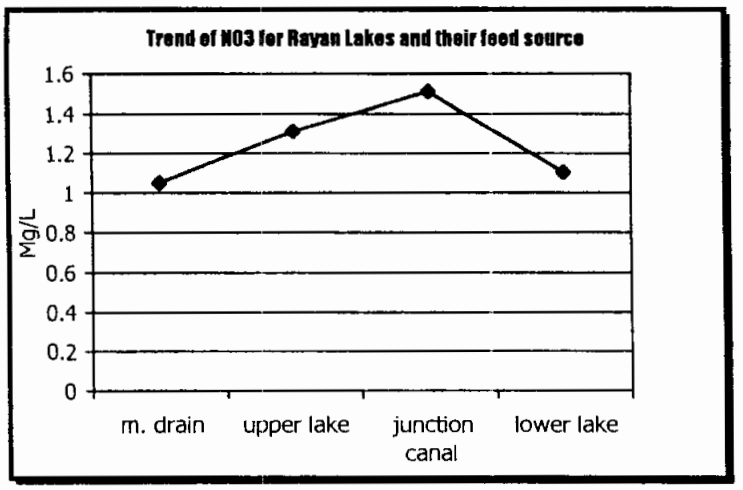
Figure (21): Trends of total phosphorus (TP) and total nitrogen (TN) for Rayan lakes and their water feed source.



- **No3-N**

Nitrate concentration showed an increase in its level concerning the upper lake, followed by another increase concerning the junction canal, see figure (22). The increase in the level of nitrate concentration after the discharge of the intensive fish farm is attributed to the reduced farming activities in this cold season (Fish dormancy period). The intensity of farming activities will increase starting from April-May for each year.

Figure (22): Trend of nitrate-nitrogen concentration for Rayan lakes and their water feed source.



- **Metals**

Non significant increase for the values of metals copper, iron, cadmium, and zinc. Mercury and lead were absolutely not detected.

A.5. CONCLUSION

The conservation of Rayan lakes ecosystem is very important to keep the integrity of the lakes themselves in addition to other systems linked to the lakes.

The quality of the water in Rayan Lakes is dependent mainly on the receiving feed from the main drain. The source feed depends on the nature of seasonal crops and their fertilization behavior.

There is a decreasing in the water level of Rayan lakes. The decrease in the water level is attributed to: 1) establishing of new two pump stations that operating to pump $4m^3$/sec from the main drain feeding Rayan lakes and 2) increasing the demands of irrigation water for the new land reclamation areas.

The status of the upper Rayan Lake could be Oligotrophic to mesotrophic, but not highly trophic. BOD_5 and COD values for the lake indicating a good self-purification capacity due to the good water mobility through the lake towards the junction canal.

The lower Rayan Lake shows continuous increase in its salinity level with 12.4% for the year 1999/2000 and with 10.1% for the year 2000/2001.

The well developed submerged hydrophyte plant communities in the lower lake indicating a good light ratio penetrating the water of the lake. Light penetration means a high level of water transparency, which could be attributed to some factors. The first acting factor is the limited water currents in the lower lake. The second one is the satisfactory level of water purification a role done by the junction canal through high water current speed and wetland vegetation communities along the banks of the canal. The vegetation community plays a good role of nitrogen and phosphorus removal through the physical and absorption factors played by the roots of natural wetland vegetation community. The high water current speed in the junction canal between the two Rayan lakes plays an important role in reducing BOD_5 value of the water, improving the water quality.

Natural wetland vegetation communities surrounding both of the lakes and their junction canal are exposed now to reduction in their sizes by the continuous reduction of water level in the lakes. The reduction of wetland size could have some adverse effects. These effects can include the following:

1. The water quality of the lower lake
2. The bird community which can find their shelter, nursery and nests in these wetland communities.
3. The fish communities that can also find their source of food and shelter among the enormous area of plant roots and submerged plant communities.

4.2. B. WATER QUALITY AND FISH FARMS IN WADI EL-RAYAN PROTECTED AREA

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B.1. INTRODUCTION

In the seventies two lakes were created in the lower portion of Wadi El Rayan sub-depression to channel out excess agricultural drainage water in order to slow-down the increase of the water-table in Fayoum main depression and in the Qarun lake. The creation of a large body of water in this hyper-arid area had a striking ecological impact: new species of plants, mammals, birds and invertebrates moved to Wadi El Rayan area (Saleh, 1998).

Although aquacultures represent an ancient practice, they have a weak scientific basis. Aquaculture technologies do not take in consideration the impacts on the whole aquatic and associated systems (especially in a protected area). In Europe, a number of studies have been carried out in order to determine the source and nature of effluents discharged from fish farms and their fate in the receiving water bodies. The kinds and nature of these effluents can be simplified as follows:

1. Effluent water with a high load of fecal matter and waste food.
2. Effluent water loaded with the chemical compounds such as antibiotics and fungicides.
3. Alteration of the lake due to biological deposits above the bed on the hydrodynamic features of the locality (sedimentation and obstruction of coastal flows).
4. Unfavorable environmental conditions due to erroneous choices in the location of aquaculture activities (i.e. insufficient water exchange or lack in the water column depth.).

The waste entering the receiving lake's water from these fish farms consist of solid or soluble wastes. Solid waste products may occur in a suspended form or may accumulate on the sediment, and consist mainly of organic carbon and nitrogen compounds. The soluble wastes are generally derived from 1) the metabolic products of the culture stock, or 2) the solid wastes through decomposition and leaching. The Biochemical Oxygen Demand (BOD_5) of waste material, which is a measure of oxygen required by microorganisms to decompose organic matter, is a valuable parameter to evaluate the extent of pollutant wastes, (IUCN, 1999b).

The impact on the environment is more direct in cage cultures and is more pronounced when large numbers are concentrated in protected areas with an insufficient water exchange. The environmental impact of cage farming has been a subject of scientific attention in recent years, especially in Northern European countries where cage farming of salmonids has become the major industry. (IUCN, 1999b)

B.1.1. Fish farms in WRPA

2300 feddans (966 ha) of fish farms had been authorized by EEAA and given operational licenses from the ministry of agriculture since 1995 and 1996. 1000 feddans (420 ha) of which are representing an acting intensive fish farm and 1300 feddans (546 ha) are representing an under construction extensive one.

B.1.1.1 Intensive Fish Farm

The Fish Farm operating in WRPA at the beginning of the junction canal between the two lakes (position: 30.45°N, 29.2336°W) is a private project founded by the EU. On 1995 this aquaculture project submitted to EEAA the EIA for an extensive fish farm (Grey List in EEAA guidelines) and in March 1995 the EEAA issued the license for 1000 fedans (420 ha) of intensive aquaculture for 25 years. This licence had originally been granted for extensive fish farming (ponds with 1

fish/m³ of water) and was subsequently converted to intensive fish farming (100 fish/m³ of water). The Ministry of Agriculture, Department of Fisheries has released an Operative License.

At the present time the fish farm is operating in a surface of 42 ha with 90 ponds (on 120 foreseen), pumping 1.8 m³/sec. of water from the Upper lake, producing 5 ton of fish per pond two time per year and discharging water in the junction canal. The breaded species are Tilapia nilotica (prevalently) and mullet and the declared profit is 800 000 LE per year. 25 people are the permanent staff in the Fish Farm.

B.1.1.2. Extensive fish farm

In March 1996, EEAA licensed for 25 years the Cooperative for Aquaculture in Fayoum to establish a 546 ha (1300 feddan) extensive aquaculture in WRPA. The chairman of the Cooperative submitted to EEAA the EIA. The Ministry of Agriculture, Department of Fisheries has released an Operative License. The exact location of the fish farm was specified neither in the license nor in the EIA, if not with the generic expression "in the East and West Side of the channel between the two lakes". The aquaculture project foreseen the building of 200 ponds, for the realization of 100 farms, each one composed by 1 nursery and 2 ponds. The water input from the Upper Lake will be of 2 m³/sec and the permanent personnel will be 100 farmers. The breaded species will be Tilapia nilotica (with a density of 1 fish/m³) and the estimated productivity is 800 ton/year.

B.1.2. Environmental impact of the fish farms

The major impact of the fish farm is related to water consumption and wastewater outputs (IUCN, 1998). Regarding the pollution risk, there are some risk of de-oxygenation and toxicity for the use of hormones and chemicals (formaline, malaquite green and potassium permanganate added only if necessary

and in very small concentration). The main problem could be related to the ammonium and nutrients (phosphorus and nitrogen) concentrations. Even if the Lower Lake appears to be mesotrophic, the experts consider that the phosphorus generated by the fish farm will double the rate of enrichment of this element in the lake.

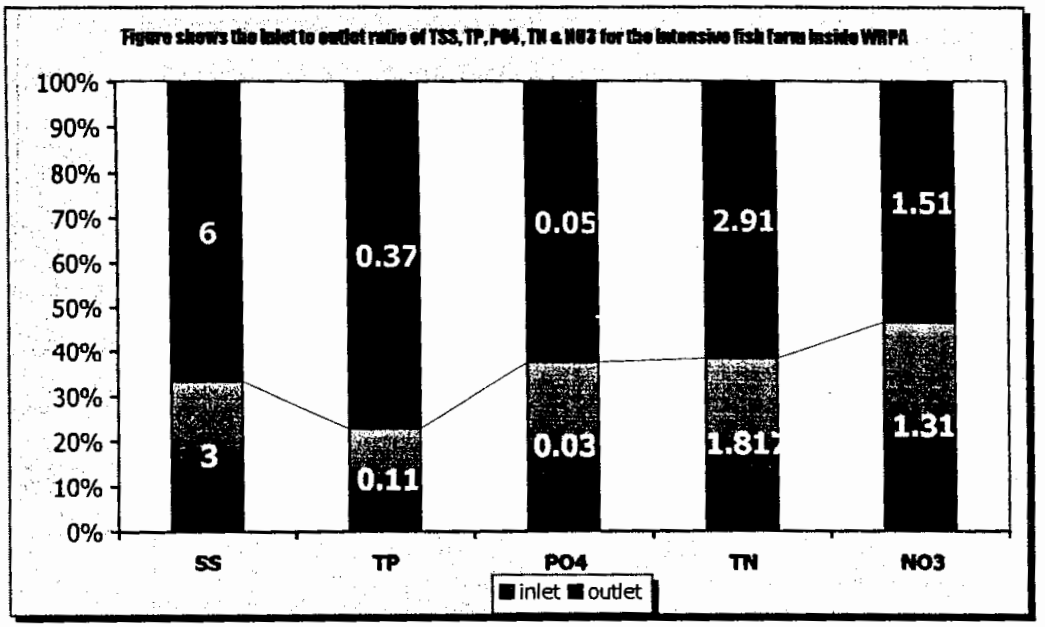
B.2. MONITORING DATA AND RESULTS

The most recent analyses done by Wadi El-Rayan protected area staff, in collaboration with the EEAA central laboratory, (as a part of the continuous seasonal monitoring program for water quality monitoring). The date of analyses was 11/12/2001 and introduced the following results: 1) the inlet to the intensive fish farm, and 2) the outlet of the water and wastewater of the farm. The outlet was taken after 100 m of the point of discharging to the junction canal. Table (17) shows the results of the analyses:

Table (17): The results of the analyses of water samples taken from the inlet and outlet of the intensive fish farm

Parameters	Inlet	Outlet
PH	8.5	8.0
PO_4 (Mg/L)	0.03	0.05
Total Phosphorus (Mg/L)	0.11	0.37
Nitrates (Mg/L)	1.31	1.51
Total Nitrogen (Mg/L)	1.817	2.91
TDS (Mg/L)	1618	1597
Suspended Solids (Mg/L)	3.0	6.0

Figure (23): The inlet to outlet ratio of the concentrations of TSS, TP, PO_4 & NO_3 for the intensive fish farm inside WRPA



In relation to the present trophic status in the lakes and considering the most resent concentration values of nitrates, the limiting element would appear to be nitrogen. The most recent data on WRPA lower Rayan lake reveal that the primary production of the lake is probably nitrogen dependent, since the nitrogen/phosphorus ratio is almost 0.44. The literature (Mason, 1981; Ambrosetti *et al.*, 1992; Marchetti, 1993) (after IUCN, 2001a) show that eutrophication in lakes is nitrogen dependent only when the nitrogen/ phosphorus ratio is below 10, signifying that an increase in the nitrogen level could cause eutrophic conditions. (IUCN, 1999b).

The data showing that:

1. There is an increase in the level of the total suspended solids concentration for the outlet than the inlet by a ratio of more than 65% (Figure 23)
2. There is an increase in the level of the total phosphorus concentration for the outlet than the inlet by a ratio of more than 75% (Figure 23)

3. There is an increase in the level of the ortho-phosphorus concentration for the outlet than the inlet by a ratio of more than 60% (Figure 23)
4. There is an increase in the level of the total nitrogen content for the outlet than the inlet by a ratio of more than 60% (Figure 23)
5. There is an increase in the level of nitrate concentration for the outlet than the inlet by a ratio of more than 55% (Figure 23)

These results are revealing a significant increase in the previous parameters. The increase is not high, for the reason of the dormant season. Fish farming activities (including fish food supply) are at their minimum. But even at this point the intensive aquaculture still discharging significant concentrations of different parameters that enhancing the change of the trophic state of the water of the Lower Rayan Lake.

The concentration of phosphorus is fairly high in both lakes, compared with the OECD (Organisation de Cooperation et de Developpment Economiques, France) criteria for eutrophication (IUCN, 1998) and with Saleh *et al.*, research figures (1988, 1998). From among all the different factors influencing the productivity of a specific water body, it seems that the increase in the salinity level may represent the most effective limiting factor. (IUCN, 1999b).

- The monitoring report for the quality of water in Rayan Lakes showed continuous increase in the TDS (in turn the salinity) of the lower lake in addition to accumulating of different fractions of phosphorus and nitrogen (the significant elements causing eutrophication). This will affect, dramatically, the lake by the factors of:
    1. Encouraging the growth of toxic algae which are limiting to the economic fish production (as occurred before in the upper lake and recorded by the National Institution of Oceanography and Fisheries – Rayan research branch unit, intesive growth of *Microsystis sp.*).

2. The eutrophic water supports the dense algal growth creating a turbidity of the water that resulting in declining the growth of the submerged hydrophytes as *Myriophyllum spicatum* and *Potamogeton pectinatus,* which depend mainly on the light penetration to the water layers (El-Hennawy, 2000). The submerged hydrophytes represent the main shelter for the fish reproduction (with the roots of the emergent hydrophytes).

3. The eutrophication problem of rayan Lakes could be the 1st enemy for the sustainability of the lakes. The development of all the area is mainly dependent on the presence of this clean aquatic ecosystem (Ecotourism activities, bird watching, traditional fishing dependent people, etc...).

In addition to the previous factors, the evaporation represents the major one affecting the increasing of the salinity of the lower lake. The culture basins of the existing intensive fish farm, and the under-construction extensive one contribute the loss of the water through the evaporation factor, in addition to the direct evaporation from the entire surface of the lower lake itself. The use of the water of the upper lake (fish farms + irrigation of more than 4000 feddans of the land reclamation project) in addition to the evaporation factors is leading now to the concentration of the elements and nutrients in the Lower lake raising its salinity level.

B.3. RECOMMENDATION

- We strongly recommend stopping any authorization for any new fish farming (either normal aquaculture basins or fish cages) in order to stop the negative impact on the two Rayan lakes. The National Institute of Oceanography and Fisheries, represented in its research unit in Rayan, strongly recommend stopping of any new fish farms and cages after their long studies on the biological assessment of water quality in Rayan.

- We also strongly recommend for the EEAA to oblige the two existing fish farms (the acting intensive one and the under-construction extensive one) to create artificial wetlands for the natural treatment of their wastewater.

- In order to reduce the impact of the fish farm on the quality of the water of the lakes, Conte and Picci (IUCN, 1998) suggested that the more effective solution is the constructed wetlands system. According to that, the PMU organized the mission of two experts of constructed wetland that assessed the feasibility of the using the constructed wetland system to the treatment of the fish farm wastewater (IUCN, 1999b). Using as a test the small artificial wetland were 30 ponds of the fish farm are already discharging the wastewater, the experts collected some samples of water on the inlet and on the outlet of the wetland. The results of the analysis reveals very good nitrate removal (98.4%) by means of microbiological action and plants uptake, the removal of 26.7% of total phosphorus due to the processes of sedimentation and a 5.1% removal of soluble phosphates. The expert's conclusion is that the construction of a wetland of approximately 55 ha will be the best solution in order to reduce the impact of the wastewater of the fish farm on the lower lake.

- Following the recommendations of the experts, on September 1999 an official letter was addressed to the owners of the fish farm by PMU and EEAA asking the realization of the constructed wetland and the submission of a new EIA, specific for intensive fish farm and following the EEAA guidelines.

- As a result of the reuse of the agricultural drainage water for irrigation purposes, the receiving water quantity by the two Rayan lakes started to decrease. This will increase the impact on the ecosystem of the lakes. The recommendation in this case is a trial to keep the integrity of the ecosystem in Wadi El-Rayan.

IMPACT MONITORING FOR ECONOMIC ACTIVITIES SITE INSPECTION: WASTE MONITORING

MONITOPRING REPORT

2001

4.3. IMPACT MONITORING OF THE ECONOMIC ACTIVITIES SITE INSPECTION: WASTE MONITORING:

By
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4.3.1. INTRODUCTION

According to the important presence of economic activities inside its boundaries, WRPA can be considered a Managed Resource Protected Area (IUCN Type VI category; IUCN, 1998). For this reason, a crucial point of the monitoring program is to monitor the human activities in order to ensure compliance with regulations stipulated in existing licenses and to reduce their impact on the environment. Table (18) summarises the human activities existing inside WRPA.

Table (18): The main characteristic of the human activities inside WRPA

TYPE OF ACTIVITY	EXTENSION (HECTARES)	NUMBER OF PEOPLE	ENVIRONMENTAL IMPACT LEVEL (EEAA LISTS)
Oil Extraction	50	23	Black list
Salt Extraction	Negligible	50 approx.	White List
Ice Factory	Negligible	1	
Eco-tourist Services	16.94	11 operators and approx. 150 000 tourists	Black List
Land Reclamation	2600	10 000	Black List
Traditional Fishing	11434 (lakes and channel)	1777	
Intensive Fish Farm	42	25	Grey List
Extensive Fish Farm	546	1 (construction phase)	Grey List
Fish Cages	Negligible	12	Grey List
WRPA Headquarters	Negligible	22	White List
Coptic Monastery	8	6	White List

4.3.2. MATERIALS AND METHODS

PERSONNEL	EQUIPMENT	FREQUENCY	OBJECT
2 Ranger	Data Sheet	Every 3 months	Control of landscape pollution

WRPA staff always go to the **Human Activity Site** and asking the people there (whatever owners or workers) about the waste treatment system which they follow. All the data were recorded in the specific data sheet, then inspecting the site to make a comparison between what the people said and the fact. The specific data sheet includes the following:

Data sheet form.

Date	Type of activity	Collection (Y/N)	Treatment	Frequencies of treatment	Recycling	Landscape pollution	Comments

4.3.3. RESULTS

4.3.3.1. Oil Extraction

They collect the garbage in plastic bags and transfere it to the waste disposal (we saw the plastic bags contained the garbage).

After any digging processes, the oil company cleans the location and transfere the solid garbage to the waste disposal site outside the protected area. They also remove the oil which might be spelled by vaccum pumb under WRPA regulations.

Sewage treatment: They have solid septic tank discharged weekly.

The degree of landscape pollution ([1]) in the Oil Company is **3.**

[1] Degree Of Landscape Pollution: 1= High density of rubbish ,2= Medium Density of rubbish , 3= Low density of rubbish , 4= Absence of rubbish

4.3.3.2. Land Reclamation (LR)

The population of The Land Reclamation village is low because their field's soil is bad as land reclamation, so that it needs a lot of money to improve its quality.

In contrary they are very poor and a lot of those people deserted their houses and fields because of this. So the inhabitants in the LR is not more than 500 family not as the charge in the LR told us they are 10 000family.

IN the LR site little quantity of garbage strewn on the sides of the road although the people used to burn their garbage. If the population started to increase it will be a problem for the protected area, so WRPA staff is usually trying to support the land reclamation community by raising their awareness level as a part of public awareness program of WRPA.

IT is not clear if the ADMINISTRATION UNIT of the LR will have a waste treatment facility in the future or not.

Swages treatment: They have a septic tanks closed to each house but it never be full or discharged untill now.

Till now The Degree of Landscape Pollution is **2.**

4.3.3.3. Intensive Fish Farm

According to the information that the charge in the fish farm told us they collect daily the garbage and transferred it in the waste disposal, but we saw some garbage in the site (plastics & bottles) especially around their junior compound.

Swages treatment: They have a septic tanks in the site but its in a bad condition and it has a lot of cracks.

WRPA notified them to take a serious procedure towards it.

The degree of landscape pollution is **2.**

ACTION:

WRPA submitted a report to the EEAA about the violation of the fish farm

THE Nature Conservation Sector (NCS) chief held many meetings with the owner who undertakes to avoid that matter. Also, PAMU held many meetings with the site manger of the fish farm who carried out our instructions.

4.3.3.4. Fish Cages

Three sites for the fish cages are located in the 2nd lake of WRPA.

- The 1st site consists of 8 cages (which still under the liscened number which is 50 cages). Garbege were continuously collected and transferred outside the protected area.
- The 2nd site consists of 4 cages (which also still under the liscened number). Garbege collection follows the same system as mentioned above).
- The 3rd site consists of 5 cages (also still under the liscened number), with the same system of garbage collection.

Sewage treatment: The three sites are empty from the septic tanks

The degree of landscape pollution is **1.**

ACTION:

The fish cages must be transferred to the first lake of WR according to a meeting held between the minister of Agri. & minister of Env. On 28/4/99.

4.3.3.5. Pump Station

After the meeting that PAMU held with the site manger that site now is quite clean

Sewage treatment: There is a septic tank in the site, this tank never discharged, that the staff works only during the day and they leave afternoon and nobody stay permanently except some guards.

The degree of landscape pollution is **2.**

4.3.3.6. Ice Factory

No body permanently stayed in ice factory site, only two workers come in the morning and leave afternoon. So the landscape pollution is minimized.

The degree of landscape pollution is **3.**

4.3.3.7. Police Station

Garbage is collected in a plastic bags. Because of their depend on the preserved food, there garbage usually contains tins & cans.

Sewage treatment: There is a septic tank in the site that never discharged.

The degree of landscape pollution is **2.**

ACTION:

WRPA provided them with plastic bags and arranged with them to collect their solid wastes and transfering it by the cars of the protected area to the waste disposal site outside the area.

4.3.3.8. Coptic Monastery

The monks collect their solid wastes and transferred it outside the protected area, and they have a compost facility.

Sewage treatment: They have septic tanks in the monastery that aren't solid.

The degree of landscape pollution is **3.**

4.3.3.9. Cafeterias & Safari Camp

They collect their garbage periodically according to the visitors' number.

Sewage treatment: For the cafeterias, the workers and the visitors use the public W.C. in the visitor area.

For the safari camp, they have private W.C. with a septic tank that discharged periodically by an equipped truck to the nearest station designated for such a purpose.

The degree of landscape pollution is **3.**

4.3.4. RECOMMENDATIONS

1- Periodical Meeting between WRPA staff and the human activities owners should be organized, so we can inform them by this way about our environmental viewpoints in the management of the area and to make the possible balance between the Environmental specifications and the economic requirements. Also it will be a good step for the public awareness.

2- Estimation legal committee from EEAA must be organized to visit the area periodically to be involved with the WRPA staff in the problems of the area. As well as, to help the WRPA to take deterrent procedures against violators and to support the WRPA in the judicial authorities to rush them up to carry out the penalties of the law against violators.

3- For the Oil extraction we must have a plan to face any potential disaster that could happen as a result of their activities. This plan must be prepared with coordination between EEAA, WRPA staff , and Qaruon Oil Company.

4- For the land reclamation, the environmental public awareness program should has more support to improve the behaviors of the people.

5- coordinate with administration unit of the land reclamation is a must to offer a waste treatment facility.

VISITOR MONITORING FOR WRPA

MONITORING REPORT

(DECEMBER 2001)

4.4. VISITOR MONITORING PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION

By
Arafa El Sayed
Senior Coordinator of communication with local stakeholders and public awareness program

4.4.1. INTRODUCTION

4.4.1.1. Environmental Awareness

Definition

The standing on the sensitivity and the knowledge of environmental problem reasons and ways for their solution. From the other hand, necessity that the passion and the knowledge sides have to parallel and that the environmental awareness is the first step for the formation of the environmental directions, which control the individual attitude.

4.4.1.2. Environmental Education

Definition

Science of formation of traditions, skills necessary for understanding and estimation of the complex relationships that connect the human with his biophysical surrounding and that explain the necessity of environmental resources conservation. It also the necessity of well investment for the human, keeping his good life and raising his leaving levels.

Objectives

Awareness:

For helping of individuals and communities acquiring awareness and sensitivity towards the integrated environment and its connected problems.

Knowledge:

For helping of individuals and communities to have the basic understanding for the integrated environment and its connected problems and the responsibility of humanity and its role.

Behaviour:

The ways for helping individuals and communities to have the social tradition and strong feeling towards the environment and positive and effective sharing in its loyalty protection and improvement.

Skills

For helping of individuals and communities to have the skills for detecting the environmental problems and their solution.

Sharing

For helping of individuals and communities to develope feeling the responsibility and emergency that related to the environmental problems to be sure about the suitable way for the solution of these problems.

4.4.1.3. Visitor Monitoring

Regular visitor survey

According to IUCN classification of the protected areas, WRPA representing the 6th type as a multi used managed area. Tourism and recreation are of the main purposes of WRPA. Habitat diversity, unique geological features, rare ecosystems with their content of wild life and manificent saharan senes and aquatic senes attracting many local and foreigner visitors. Simplified ecotourism facilities were established by private sector (simple ecolodge inside WRPA). Interesting camping sites, bird watching sites and some visitor facilities were provided by the protected area in collaboration with the Egyptian Italian project support to WRPA (1998-2001). The protected area staff, with IUCN technical assistance, developped a monitoring program for visitors in order to enhance the

capacity for ecotourism facilities supporting the ecotourism as a wise way for investing the nature. Assessing the impact of the visitors and tourism on the protected area is also one of the main aims of this monitoring program.

Inauguration of WRPA visitor center (June 2001) was one of the achievements of the Egyptian Italian Project that going to raise and support public environmental awarenes program of the protected area.

4.4.2. MATERIAL AND METHODS

The EEAA annual tourist's statistics are extrapolate from the protected area entrance tickets. This count didn't take in consideration the big amount of tourists that are exempted to the ticket fees; Schools, Universities and groups of people invited by Fayoum Governorate or by EEAA.

From Feb 1999 the PAMU started a regular count of tourist visiting WRPA. Every month, during random working days and weekend, at the main gate of WRPA or at the asphalt road near the waterfall area, stoping the tourists and recording their number, age, nationality and main transportation to WRPA.

The mean of data recorded during different working days in one month is multiplied by the number of working days of the month. The same operation for the data collected during the weekends and during the national holydays. The next report introducing the most recent data collected during the period from September to January 2002.

Main characteristics of the PAMU tourist survey in WRPA.

PERSONNEL REQUUIRED	EQUIPMENT	FREQUENCY	OBJECT
2 personnel	Pencil and data sheets	At least 4 days per month	Collection of vital statistic of WRPA tourists

4.4.3. RESULT

Tables 18, 19 show the percentage of different categories of the visitors coming to WRPA and their age composition for the period from Augost to December 2001.

Table (18) Statistics of tourists visiting WRPA from 8/2001 to 12/2001.

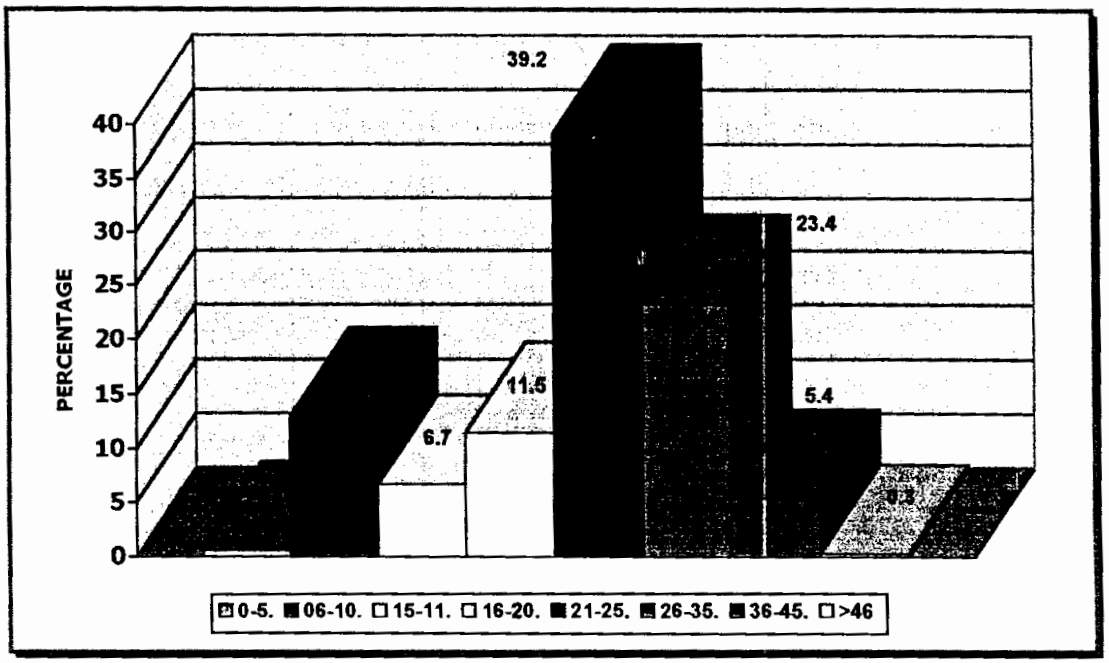
TOURIST'S CATEGORIES	PERCENTAGE	ESTIMATED NUMBER
Residents	99.15	50562.2
Foreigners	0.85	220.8
Adults	79.8	40524.8
Children	20.2	10258.2
Arrived WRPA by private car	46	23360.2
Arrived WRPA by public mean of transportation	54	27422.8
ESTIMATED TOTAL NUMBER OF TOURISTS		50783

Table (19) Age composition of WRPA visitors from 8/2001 to 12/2001.

AGE CATEGORIES	PERCENTAGE	NUMBER
0-5	0.6	305.70
6-10	12.9	6551.00
11-15	6.7	3402.46
16-20	11.5	5840.04
21-25	39.2	19906.94
26-35	23.4	11883.23
36-45	5.4	2742.28
>46	0.3	152.35

Figure (24) shows a histogram explaining the age variation among the different categories of the visitors for WRPA

Figure (24): The variation of ages for WRPA visitors



4.4.4. DISCUSSION

It has been found that the estimated number of visitors to WRPA, In the last 6 months, is less than the first 6 months of the year because of: 1) the hot weather (the temperature sometimes reach to 45), 2) the starting of the 1st semester of the studing year and 3) the fasting season (Ramadan) also included through this period.

The staff direct observations show that the majority of the resident visitors (local people) come mainly to enjoy with the waterfalls (about 90%). The foreigners are coming mainly for their nature interest.

A small percentage of foreigners is beyond-estimation due to their desert navigation that most of them do not enter to WRPA from the main gate, (Figure 25).

20.2% of the public visitors are children (under 15) and 79.8% are adults (under 35). This data confirm the high potentiality of WRPA as a focus area for environmental education. (Figure 26)

Most of the visitors arrive to WRPA by public transportation that there is no fixed transportation to WRPA. (Figure 27)

The majority of the visitors between (21:25 year) about (39.2%) most of them still studying at the university.

Figure (25): Percentage of the foreigner and resident visitors for WRPA

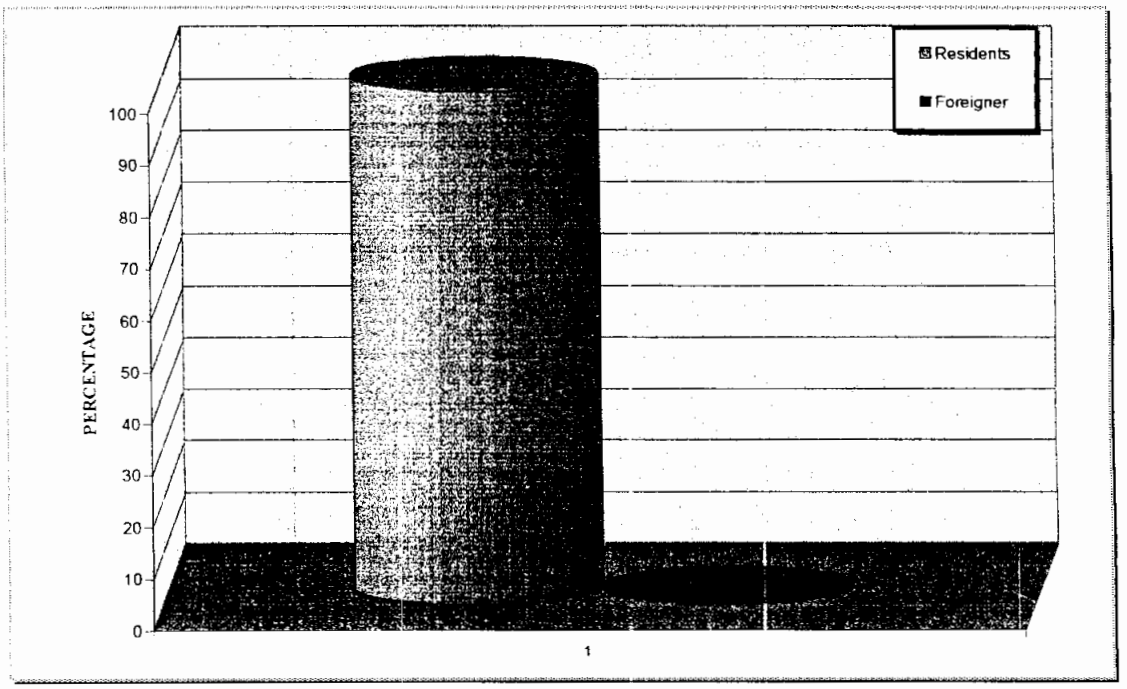


Figure (26): Percentage of the adults and shildren visitors for WRPA

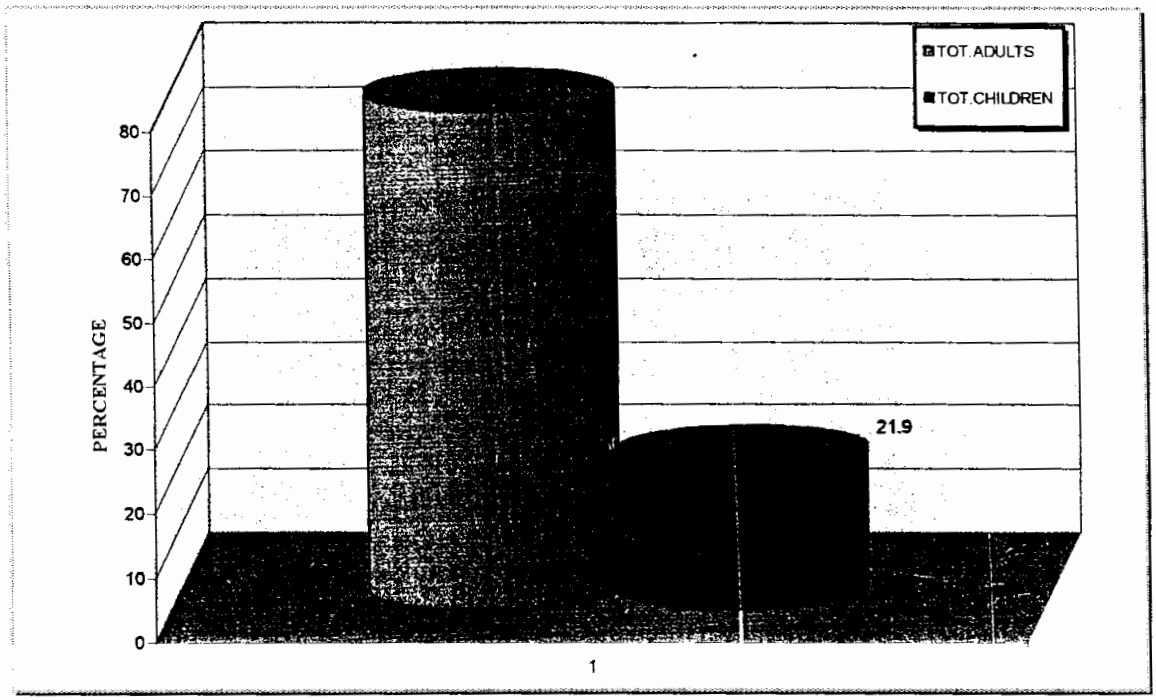
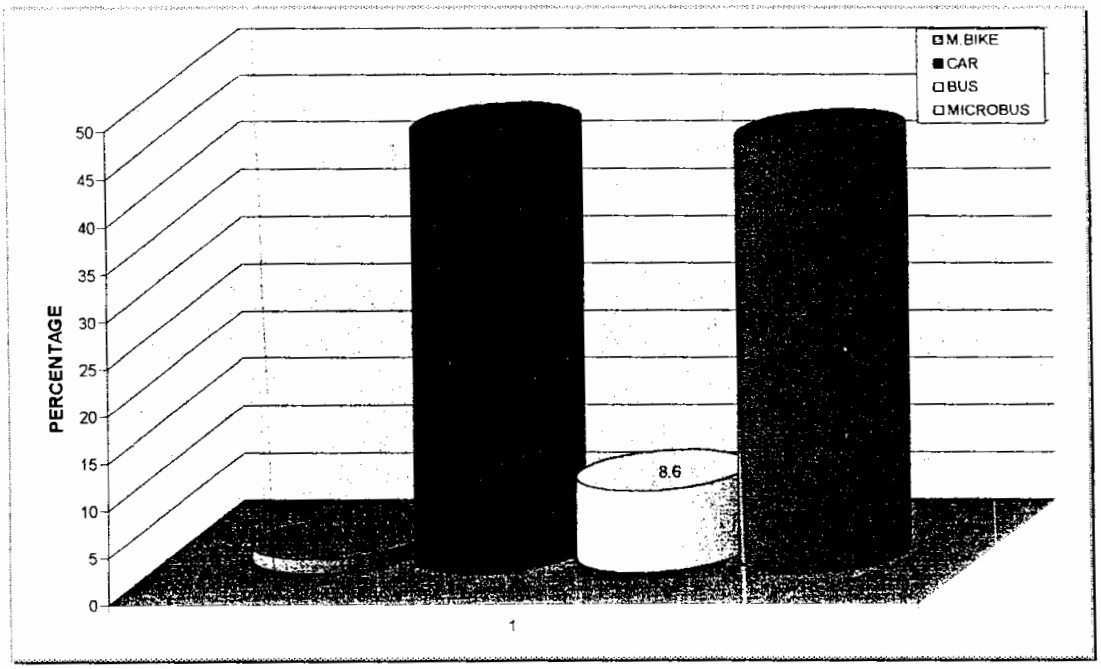


Figure (27): Percentage of different means of transportations to WRPA used by visitors



PART V

5. BIBLIOGRAPHY & ANNEXES

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5.1. BIBLIOGRAPHY

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5.2. ANNEXES

Annex 1

List of insect species recorded inside WRPA (after IUCN, 1999)

SPECIES	FAMILY	ORDER
Agelena lepida	Agelenidae	Araneida
Argiope trifasciata, Argiope lobata, Cyrtophora citricola	Araneidae	
Cheiracanthium sp.	Clubionidae	
Dictyna sp.	Dictynidae	
Stegodyphus sp.	Eresidae	
Pterotricha schaefferi, Haplodrassus sp., Setaphis sp.	Gnaphosidae	
Trochosa sp., Pirata sp., Evippa ungulata	Lycosidae	
Peucetia sp., Oxyopes sp.	Oxyopidae	
Philodromus sp., Thanatus sp., Ebo sp.	Philodromidae	
Mogrus bonnetii	Salticidae	
Tetragnatha nitens	Tetragnathidae	
Theridion sp.	Theridiidae	
Thomisus onustus	Thomosidae	
Buthacus leptochelys, Androctonus amoreuxi		Scorpionida
Olpium kochi	Olpiidae	Pseudoscorpionida
Geleodes graecus		Solplugida
Suborder Ixodides		Acarida

Annex 2

List of aquatic invertebrates inside WRPA lakes (after IUCN, 1999)

CLASS	ORDER	FAMILY/GENUS/SPECIES
Insecta	Diptera	Tipulidae, Chironomidae
	Coleoptera	Dytiscidae
	Odonata	Libellulidae
Mollusca	Gastropoda	*Melanoids tuberculata, Thedoxus niloticus, Colesptera bulimoides, Bellamya unicolar, Semisalsa sp., Valvata nilotica, Physa acuta*
Mollusca	Bivalva	*Corbicula fluminralis*
Crustacea	Amphipoda	*Gammarus sp., Corophium sp.,*
	Ostracoda	*Cyprideis torosa*
	Decapoda	*Palaemon longinostris*
Anellida	Oligochaeta	Lumbricidae, Tubificidae

Annex 3

List of reptile species inside WRPA (afte IUCN, 1999)

No.	SCIENTIFIC NAME	ENGLISH NAME
1	*Ptyodactylus hasselquistii*	Fan-footed Gecko
2	*Cerastes cerastea,*	Lesser Ceraster Viper
3	*Cerastes vipera*	Horned viper
4	*Psammophis schokari*	Sshokari Sand Snake
5	*Lytorhynchus diadema*	Diademed Sand Snake
6	*Malpolon moilensis*	Moila Snake
7	*Varanus griseus*	Desert Monitor
8	*Mesalina rubropunctat*	Red Spotted Lizered
9	*Acanthodactylus scutellatus*	Nidua Lizered
10	*Tropiocolores steudneri*	Steudners Gecko
11	*Tarrentola annularis*	Egyptian Gecko
12	*Stenodactylus*	Peteries Gecko
13	*Stenodactylus stenodactylus*	Elegant Gecko
14	*Sphenops sepsoides*	Audouins Sand skink

Annex 4

List of fish species as recorded by WRPA staff

No.	LATINE NAME	ENGLISH NAME
1	*Alestes nurese*	Imberi
2	*Aphanius disper*	Tooth carp
3	*Aphanius fasciatus*	Tominnow – Pastrica
4	*Altherina boyeri*	Silverside
5	*Altherina spp.,*	Silverside
6	*Bagrus bayad*	Forsskal catfish
7	*Bagrus docmak*	Catfish
8	*Bagrus spp.,*	Catfish
9	*Barbus bynni*	Barbel
10	*Clarias lazera*	African catfish
11	*Ctenopharyngodon idella*	Grass carp
12	*Cyprinus carpio*	Common carp
13	*Dicentrarchus labrax*	Seabass
14	*Dicentrarchus punctatus*	Spotted seabass
15	*Haplochromis spp.,*	Cichlid
16	*Hemichromis bimaculatus*	Cichlid
17	*Hemiramphus far*	Halfbeak
18	*Labeo nilotica*	Nile carp
19	*Lates niloticus*	Nile perch
20	*Liza aurata*	Golden grey mulet
21	*Liza ramada*	Thinlip grey mullet
22	*Mugil cephalus*	Flathead grey mullet
23	*Oreochromis aureus*	Tilapia
24	*Oreochromis niloticus*	Tilapia
25	*Sardinella spp.,*	Sardin
26	*Sarotherodon galilaeus*	Tilapia
27	*Sparus auratus*	Gilthead seabream
28	*Synodntis schall*	Barbel
29	*Tilapia zilii*	Green tilapia

Annex 5

List of plant species inside WRPA by WRPA staff

No.	LATIN NAME	COMMON NAME
1	*Adiantum capillus-veneris*	Kozbaarit el-beer
2	*Alhagi graecorum*	Aqool
3	*Arthrocnemum macrostachyum*	Shinaan
4	*Calligonum polygonoides* sub. *Comosum*	Arta/Risoo
5	*Ceratophyllum demersum*	Nakshoosh el-hoot
6	*Cornulaca monocantha*	Shoak ed-deeb
7	*Cressa cretica*	Nadwa
8	*Cynanchum acutum*	Olleiq
9	*Cynodon dactylon*	Nigeel
10	*Cyperus laevigatus*	Sead
11	*Desmostachya bipinnata*	Halfa
12	*Haloxylon salicornicum*	---
13	*Imberata Cylindrica*	Halfa deil el-qott
14	*Juncu rigidus*	Samaar morr
15	*Juncus acutus*	Samaar morr
16	*Launaea nudicaulis*	---
17	*Melilotus indicus*	Hendaqooq morr
18	*Myriophyllum spicatum*	Hamool el-maia
19	*Najas armata*	Hamool
20	*Nitraria retusa*	Gharqad/Ghardaq
21	*Phoenix dactylifera*	Hagna
22	*Phragmites australis*	Nakheel el-balah
23	*Pluchea dioscoridis*	Barnoof
24	*Polypogon monospliensis*	Deil el-qott
25	*Potamogeton pectinatus*	Hamool el-maia
26	*Ranunculus sceleratus*	Zaghlanta
27	*Rumex dentatus*	Khilla
28	*Salsola imbricata* subsp. *Gaetula*	Khareet/Kreesh
29	*Scirpus maritimus*	---
30	*Sonchus maritimus*	---
31	*Spergularia marina*	Samaar
32	*Sporopolus spicatus*	Nigeel shoaky
33	*Stipagrostis ciliata*	Homareet
34	*Tamarix nilotica*	Abal/Tarfa
35	*Typha domingensis*	Halfa/Bardi
36	*Zygophyllum album*	Rotreet
37	*Zygophyllum coccineum*	Rotreet

Annex 6

List of bird species inside WRPA by WRPA staff

No.	LATIN NAME	ENGLISH NAME	STATUS
1.	*Tachybaptus ruficollis*	Little Grebe	Winter visitor
2.	*Podiceps cristatus*	Great Crested Grebe	Winter visitor
3.	*Podiceps nigricollis*	Black-Necked Grebe	Winter visitor
4.	*Phalacrocorax carbo*	Cormorant	Winter visitor
5.	*Ixobrychus minutus*	Little Bittern	Breeding Resident
6.	*Nycticorax nycticorax*	Night Heron	Winter visitor
7.	*Ardeola ralloides*	Squacco Heron	Resident/Migrant
8.	*Bubulcus ibis*	Cattle Egret	Resident/Migrant
9.	*Egretta garzetta*	Little Egret	Resident
10.	*Egretta alba*	Great White Egret	Winter visitor
11.	*Ardea cinerea*	Grey Heron	Resident
12.	*Ardea purpurea*	Purple Heron	Winter visitor
13.	*Ciconia ciconia*	White Stork	Migrant
14.	*Ciconia nigra*	Black Stork	Migrant
15.	*Plegadis falcinellus*	Glossy Ibis	Winter visitor
16.	*Platalea leucorodia*	Spoonbill	Winter visitor
17.	*Phoenicopterus ruber*	Greater Flamingo	Occasional visitor
18.	*Tadorna tadorna*	Shelduck	Occasional winter visitor
19.	*Anas penelope*	Wigeon	Winter visitor
20.	*Anas strepera*	Gadwall	Winter visitor
21.	*Anas crecca*	Teal	Winter visitor
22.	*Anas acuta*	Pintail	Winter visitor
23.	*Anas clypeata*	Shoveler	Winter visitor
24.	*Anas platyrhynchos*	Mallard	Winter visitor
25.	*Anas querquedula*	Garganey	Winter visitor
26.	*Netta rufina*	Red-crested Pochard	Winter visitor
27.	*Aythya ferina*	Pochard	Winter visitor
28.	*Aythya fuligula*	Tufted Duck	Winter visitor
29.	*Aythya nyroca*	Ferruginous Duck	Winter visitor
30.	*Milvus migrans*	Black Kite	Migrant
31.	*Circaetus gallicus*	Short-toed Eagle	Migrant
32.	*Circus aeruginosus*	Marsh Harrier	Resident/Winter visitor
33.	*Circus pygargus*	Montagu's Harrier	Migrant
34.	*Accipiter brevipes*	Levant Sparrowhawk	Migrant
35.	*Accipiter nisus*	Sparrowhawk	Migrant
36.	*Buteo buteo*	Buzzard	Migrant
37.	*Buteo rufinus*	Long-legged Buzzard	Migrant
38.	*Pandion haeliatus*	Osprey	Migrant
39.	*Falco concolor*	Sooty falcon	Breeding summer visitor
40.	*Falco biarmicus*	Lanner	Resident
41.	*Falco naumanni*	Lesser Kestrel	Migrant
42.	*Falco pelegrinoides*	Barbary's Falcon	Migrant
43.	*Falco tinnunculus*	Kestrel	Resident

44.	*Coturnix coturnix*	Quail	Winter visitor
45.	*Porzana porzana*	Spotted Crake	Migrant
46.	*Porphyrio porphyrio*	Purple Gallinule	Breeding Resident
47.	*Gallinula chloropus*	Moorhen	Resident/Winter visitor
48.	*Fulica atra*	Coot	Resident/Winter visitor
49.	*Grus grus*	Crane	Migrant
50.	*Himantopus himantopus*	Black-winged Stilt	Winter visitor
51.	*Burhinus oedicneumus*	Stone-curlew	Migrant
52.	*Cursorius cursor*	Cream Colored Corser	Breeding Resident
53.	*Glareola pratincola*	Collared Pratincole	Migrant
54.	*Charadrius alexandrinus*	Kentish Plover	Resident
55.	*Charadrius dubius*	Little Ringed Plover	Migrant
56.	*Charadrius hiaticula*	Ringed Plover	Winter visitor
57.	*Charadrius leschenaultii*	Greater Sand Plover	Migrant
58.	*Hoplopterus spinosus*	Spur-winged plover	Breeding Resident
59.	*Calidris alpina*	Dunlin	Migrant
60.	*Calidris temminckii*	Temminck's Stint	Winter visitor
61.	*Calidris alba*	Sanderling	Migrant
62.	*Gallinago media*	Great Snipe	Migrant
63.	*Limosa limosa*	Black-tailed Godwit	Migrant
64.	*Tringa glareola*	Wood Sandpiper	Migrant
65.	*Tringa nebularia*	Greenshank	Resident
66.	*Tringa ochropus*	Green Sandpiper	Winter visitor
67.	*Tringa stagnatilis*	Marsh Sandpiper	Winter visitor
68.	*Tringa totanus*	Redshank	Winter visitor
69.	*Actitis hypoleucos*	Common Sandpiper	Migrant
70.	*Larus fuscus*	Lesser Black-backed Gull	Migrant
71.	*Larus genei*	Slender-billed Gull	Resident
72.	*Larus ichthyaetus*	Great Black-headed Gull	Winter visitor
73.	*Larus ridibundus*	Black-headed Gull	Winter visitor
74.	*Gelochelidon nilotica*	Gull-billed Tern	Migrant
75.	*Sterna albifrons*	Little Tern	Winter visitor
76.	*Sterna caspia*	Caspian Tern	Migrant
77.	*Sterna hirundo*	Common Tern	Migrant
78.	*Chlidonias hybridus*	Whiskered Tern	Migrant
79.	*Chlidonias leucopterus*	White-winged Black tern	Migrant
80.	*Chlidonias niger*	Black Tern	Migrant
81.	*Pterocles orientalis*	Black-bellied Sandgrouse	Migrant
82.	*Streptopelia decaocto*	Collared Dove	Resident
83.	*Streptopelia senegalensis*	Palm dove	Resident
84.	*Streptotelia turtur*	Turtle Dove	Resident
85.	*Centropus senegalensis*	Senegal Coucal	Resident
86.	*Cuculus canorus*	Cokoo	Migrant
87.	*Apus apus*	Commun Swift	Migrant
88.	*Apus pallidus*	Pallid Swift	Migrant
89.	*Alcedo atthis*	Kingfisher	Resident
90.	*Ceryle rudis*	Pied	Breeding Resident
91.	*Merops apiaster*	Eurasian Bee-eater	Migrant

92.	*Merops superciliosus*	Blue-cheeked Bee-eater	Summer visitor
93.	*Coracias garrulus*	Roller	Migrant
94.	*Upupa epops*	Hoopoe	Resident
95.	*Jinx torquilla*	Wryneck	Migrant
96.	*Alaemon alaudipes*	Hoopoe lark	Resident
97.	*Riparia riparia*	Sand martin	Resident
98.	*Hirundo daurica*	Red-rumped Swallow	Migrant
99.	*Hirundo rustica*	Swallow	Resident/Migrant
100.	*Delichron urbica*	House Matrin	Migrant
101.	*Anthus campestris*	Tawny Pipit	Winter visitor
102.	*Anthus cervinus*	Red-throated Pipit	Winter visitor
103.	*Anthus pratensis*	Meadow pipit	Winter visitor
104.	*Anthus trivialis*	Tree Pipit	Migrant
105.	*Motacilla flava*	Yellow Wagtail	Migrant
106.	*Motacilla alba*	White Wagtail	Winter visitor
107.	*Luscinia megarhinchos*	Nightingale	Migrant
108.	*Luscinia svecica*	Bluethroat	Winter visitor
109.	*Phoenicurus ochruros*	Black Redstart	Winter visitor
110.	*Phoenicurus phoenicurus*	Redstart	Winter visitor
111.	*Saxicola torquata*	Stonechat	Winter visitor
112.	*Saxicola rubetra*	Whinchat	Migrant
113.	*Oenanthe deserti*	Desert Wheater	Resident
114.	*Oenanthe lugens*	Mourning Wheater	Resident
115.	*Oenanthe isabellina*	Isabelline Wheatear	Winter visitor
116.	*Oenanthe leucopyga*	White-crowned Black Wheatear	Resident
117.	*Oenanthe oenanthe*	Wheatear	Migrant
118.	*Monticola saxatilis*	Rock Thrush	Winter visitor
119.	*Monticola solitarius*	Blue Rock Thrush	Winter visitor
120.	*Scotocerca inquieta*	Scrub Warbler	Breeding Resident
121.	*Prinia gracilis*	Graceful Warbler	Breeding Resident
122.	*Acrocephalus arundinaceus*	Great Reed Warbler	Migrant
123.	*Acrocephalus dumetorum*	Blyth's Reed Warbler	Migrant
124.	*Acrocephalus schoenobaenus*	Sedge Warbler	Winter visitor
125.	*Acrocephalus scirpaceus*	Reed Warbler	Resident
126.	*Acrocephalus stentoreus*	Clamorous Reed Warbler	Breeding Resident
127.	*Sylvia atricapilla*	Blackcap	Migrant
128.	*Sylvia communis*	Whitethroat	Migrant
129.	*Sylvia curruca*	Lesser Whitethroat	Migrant
130.	*Sylvia rueppelli*	Rueppell's Warbler	Migrant
131.	*Phylloscopus collybita*	Chiffchaff	Winter visitor
132.	*Phylloscopus sibilatrix*	Wood Warbler	Migrant
133.	*Muscicapa striata*	Spotted Flycatcher	Winter visitor
134.	*Ficedula albicollis*	Collared Flycatcher	Migrant
135.	*Ficedula hypoleuca*	Pied Flycatcher	Migrant
136.	*Oriolus oriolus*	Golden Oriole	Migrant
137.	*Lanius excubitor*	Great Grey Shrike	Breeding Resident
138.	*Lanius senator*	Woodchat Shrike	Migrant
139.	*Corvus ruficollis*	Brown-necked Raven	Resident

140.	*Corvus corone cornix*	Hooded Crow	Resident
141.	*Passer domesticus*	House sparrow	Migrant
142.	*Fringilla coelebs*	Chaffinch	Migrant
143.	*Locustella luscinioides*	Savi, s Warbler	Migrant
144.	*Hippolais pallida*	Olivaceous Warbler	Migrant
145.	*Phylloscopus trochilus*	Willow Warbler	Migrant
146.	*Phylloscopus bonelli*	Bonelli,s Warbler	Migrant
147.	*Erithacus rubecula*	Robin	Migrant
148.	*Sylvia cantilans*	Subalpine Warbler	Migrant
149.	*Acrocephalus melanopogon*	Moustached Warbler	Migrant
150.	*Anthus spinoletta*	Water Pipit	Migrant
151.	*Cercotrichas galactotes*	Rufus Bush Robin	Migrant
152.	*Emberiza hortulana*	Ortolan Bunting	Migrant
153.	*Oenanthe hispanica*	Black-eared Wheatear	Migrant
154.	*Otus scops*	Scops Owl	Migrant
155.	*Asio flammeus*	Short-Eared Owl	Migrant
156.	*Botaurus stellaris*	Bitern	Migrant
157.	*Carandrella brahydactyla*	Short-toed Lark	Migrant
158.	*Circus macrourus*	Palid Harrier	Migrant
159.	*Eremophila bilopha*	Temminck,s Horned Lark	Migrant
160.	*Gallinago gallinago*	Sinap	Migrant
161.	*Lanius minor*	Lesser Grey Shrike	Migrant
162.	*Philomachus pugnax*	Ruff	Migrant
163.	*Recurvirostra avosetta*	Avocet	Migrant
164.	*Sylvia melanocephala*	Sardinian Warbler	Migrant

Annex 7

List of mammal species inside WRPA

No.	ENGLISH NAME	LATIN NAME
1	Long-eared hedgehogs	*Hemiechinus auritus auritus aegypticus*
2	Giant musk shrew	*Crocidura flavescencs deitac*
3	Flower's shrew	*Crocidura floweri*
4	Greater gerbil	*Gerbillus pyramidium pyramidium*
5	Anderson's gerbil	*Gerbillus andersoni andersoni*
6	Lesser gerbil	*Gerbillus gerbillus gerbillus*
7	Charming dipodil	*Dipodillus amoenus amoenus*
8	Libyan jird	*Meriones lybicus lybicus*
9	Field rat	*Arvicanthis niloticus niloticus*
10	House rat	*Rattus rattus*
11	Brown rat	*Rattus norvegicus*
12	Bandicoot rat	*Nesokia indica suilla*
13	Desert jerboas	*Jaculus jaculus*
14	House mouse	*Mus musculus*
15	Golden jackal	*Canis aureus lupaster*
16	Fennec fox	*Fennecus zerada*
17	Red fox	*Vulpes vulpes Aegyptica*
18	Ruppell's sand fox	*Vulpes ruepelli Ruepelli*
19	African wild cat	*Felis sylvestris libyca*
20	Dorcas gazelle	*Gazella dorcas Dorcas*
21	Egyptian mongoose	*Herpestes ichneumon*
22	Weasel	*Mustela nivalis*
23	Cape hare	*Lepus capensis Rothschildi*
24	Jungle cat	*Felis chaus nilotica*
25	Slender horned gazelle	*Gazella leptocerus leptocerus*